2000 Annual Report

CDCS
CDCN

Alberta
Agriculture, Food and
Rural Development

Crop Diversification Centre South
Brooks, Alberta
Crop Diversification Centre North
Edmonton, Alberta

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Introduction

R.J. Howard and S.F. Blade

The Crop Diversification Centres North and South (CDCN and CDCS) are research and development units of the Plant Industry Division of Alberta Agriculture, Food and Rural Development (AAFRD). They focus on applied research and technology transfer in support of the horticulture, apiculture, special crop and forage industries in Alberta. The Centres' mandate of crop diversification and industry development is achieved through close partnerships with commodity organizations, grower groups, agribusinesses, university, federal and private sector researchers, agricultural colleges, and individual producers and processors.

This annual report covers the activities of staff in the New Crop Development, Horticulture, Forage, and Pest Prevention and Management Units located at CDCN and CDCS, as well as for the Food Science Program at CDCS, which is administered by the Food Processing Development Centre at Leduc. Only brief summaries of projects and trials carried out in 2000 are reported here. Please refer to the Publications and Presentations section of this report for citations of more detailed sources of information.

The Horticulture Unit is responsible for programs dealing with potato, fruit, greenhouse, nursery and vegetable crops. The unit also manages programs in plant pathology, entomology, micropropagation and market development, with specific responsibilities for the Alberta Vegetable Sales Act and Alberta Farmers' Market Program. The unit provides administrative and farm support to staff in the New Crop Development, Forage, and Pest Prevention and Management Units at CDC South's headquarters farm at Brooks and at substations in southern Alberta, as well as to the Food Science Program based at Brooks.

The New Crop Development Unit is responsible for special crop research and development at CDCN and CDCS, as well as for plant pathology, weed science, post-harvest technology, and soil and water agronomy support to the Horticulture and Forage Units at CDCS. The unit also includes an Apiculture Program based at CDCN, with a satellite office in Falher, which provides extension and regulatory services to the commercial beekeeping industry throughout Alberta.

At CDCS, Forage Unit staff are involved in research and industry development related to grass seed production, while staff in the Pest Prevention and Management Unit oversee the province's Dutch Elm Disease Prevention Program. The Food Science Program serves the research and extension needs of new and established food processors in southern Alberta, and it also provides valuable food processing and quality evaluation services to several horticulture and special crop research programs at the Centre.

Directors' Report

S.F. Blade and R.J. Howard

The arrival of the Year 2000 was much discussed and excessively publicized, but this non-event did serve as the introduction to a strong year of development and growth for the Crop Diversification Centre North (based on the northeast edge of Edmonton) and the Crop Diversification Centre South (situated just east of Brooks). Alberta's special crop, horticultural and forage industries continued to see strong growth and, consequently, the two Centres dealt with a steadily increasing demand for their services. Dedicated staff at CDCN and CDCS worked tirelessly to establish partnerships with a variety of agencies to increase their capability to provide quality research and effective technology transfer/extension services to industry. A measure of their success was the number and variety of projects undertaken and a steadily increasing flow of external funding into the research programs at both Centres.

This was an exciting year at CDCN and CDCS as a number of new personnel were added to the cadre of researchers and extension experts based at the two Centres. In addition, several staff took on new or changed responsibilities. These included:

- Dr. Rachid El Hafid, an agronomist/physiologist who joined the New Crop Development Unit. Dr. El Hafid is based at Agriculture and Agri-Food Canada's Beaverlodge Research Farm. This placement is an example of the close linkages between AAFRD and AAFC.
- Ken Lopetinsky, who has worked with AAFRD as a pulse and special crops specialist for several years, joined the CDCN team as a pulse agronomist. Ken will continue to work in Barrhead, while collaborating with the special crops program at CDCN.
- Dr. Kwesi Ampong-Nyarko, an entomologist, was hired to lead the CDCN entomology program while Kris Pruski is on educational leave. Dr. Ampong-Nyarko has several years of international experience.
- Dr. Chris Neeser joined CDCS to lead the weed science program following the retirement of Rudy Esau. Dr. Neeser has a strong background in IPM research and is involved with both horticultural and special crop projects.
- Ms. Lori Delanoy, a potato extension agronomist, will focus on new opportunities for improved production in the rapidly expanding commercial potato industry. She on the CDCS staff but is based at Taber, working closely with Clive Schaupmeyer.
- Dr. Michele Konschuh is a potato research agronomist who is currently developing a field research program dedicated to improving the potential for potato production in Alberta. She is based at CDCS.
- Mrs. Betty Vladicka, horticulture development officer at CDCN, accepted a half-time secondment with the Safe Food Assurance Systems Branch of AAFRD's Food Safety Division. This step was taken to facilitate the development of food safety programs for the horticulture and special crop industries and to enable a closer working relationship between the Plant Industry and Food Safety Divisions.
- Mr. Rudy Esau was hired on a part-time basis as a Minor Use Procurement Officer to facilitate the minor use registration of pesticides for small acreage, high value crops. This position was made possible through funds contributed by the Plant Industry Division and other members of the Prairie Pesticide Minor Use Consortium.
- Ms. Jamie Motta, entomology technician at CDCN, was seconded to the Pest Prevention and Management Unit to assist with purple loosestrife and insect pest monitoring programs.

- ❖ Several staff continued educational leave programs, e.g. Mr. Jim Calpas, greenhouse crops specialist at CDCS (Ph.D., Univ. Alberta), Ms. Shelley Woods, soil and water technologist at CDCS (Ph.D., Univ. Saskatchewan), Mr. Wes Johnson, vegetable crops technologist at CDCS (B.Sc., Univ. Lethbridge), and Mr. Kris Pruski, entomologist and micropropagation specialist at CDCN (Ph.D., Wageningen Agricultural Univ., the Netherlands).

AAFRD staff based at CDCN and CDCS work in close collaboration with a large number of AAFRD staff in other parts of the organization, universities, agricultural colleges, other federal and provincial research and development organizations, and a wide variety of industry groups. One tangible sign of our interest in collaboration was the signing of a Memorandum of Understanding between CDCN, CDCS, Olds College and the Olds College Centre for Innovation to ensure that all opportunities for cooperation and partnership will be maximized. Staff have been actively involved in AAFRD Product Teams, evaluation committees for funding agencies, such as the Alberta Agricultural Research Institute, and on industry committees. Staff also organized and participated in numerous information sessions, workshops, field days and tours during this year.

CDCS celebrated its 65th Anniversary as a provincial government research station by hosting an open house on July 28, 2000. Over 250 staff and guests attended and participated in tours, dedications, gift presentations and related activities. Former Director, Tom Krahn, dedicated a book entitled *From the Bald Prairie, A History of the Crop Diversification Centre South*, which he had authored.

This Annual Report is a summary of ongoing research and extension programs at the CDCN and CDCS. It represents the dedicated work of AAFRD staff who continue to play a major role in the development of the agricultural industry in Alberta and beyond. Additional information on any program area, including detailed research reports, is available upon request.

Food Processing Development Centre

Food Science & Technology Program

D.R. Driedger, L.R.J. Dowdell, C. Riley and M. Hansen

The objective of the food science and technology program is to strengthen and expand the capability of Alberta's food and beverage industry to meet the challenges of the marketplace through application of new technology and the development of new or improved products and processes. The program assists Alberta companies in their efforts to develop and manufacture more value-added goods from agriculture commodities. In addition, the program supports crop production research programs at CDCS by carrying out chemical analyses and sensory evaluations on new and existing crops. The food science and technology program is associated with the Leduc Food Processing Development Centre.

Research Projects

Fruit processing quality

A three-year study evaluating the organoleptic characteristics of four saskatoon berry cultivars was completed this year. Smoky, Northline, Honeywood and Thiessen cultivars were selected for the study. The objective was to identify cultivars best suited for jam, jelly, syrup, and pie filling. Attributes such as appearance, taste, texture, and overall acceptability were assessed for each cultivar. The final report has been submitted to the Alberta Agricultural Research Institute (AARI). The project was jointly funded by the AARI, Fruit Growers Society of Alberta, Saskatchewan Fruit Growers Association, and the Prairie Fruit Growers Association of Manitoba.

There is increasing interest in the commercial production of black currants in Alberta. A limited number of trials were conducted investigating the effect of harvest date on soluble solids and acidity. Trials were also conducted on the use of pectolytic enzymes during the juicing process. Black currant processing trials will be continued in following years.

Potato quality evaluation

In collaboration with Dr. Dermot Lynch, potato breeder at the Agriculture and Agri-Food Canada Research Centre, Lethbridge, the commercial processing quality of samples from the Potato Consortium Study and the Processing Trial Research Project were evaluated. Samples were evaluated for french frying, chipping, boiling and baking qualities.

Post-harvest handling of saskatoon berries

Preliminary trials were conducted to investigate the possibility of extending the shelf life of fresh saskatoon berries. Controlled atmosphere storage with elevated carbon dioxide showed some potential for delaying mold development. Modified atmosphere packaging trials were largely unsuccessful because of condensation inside the package and subsequent mold growth.

Service to other programs at CDCS

Essential oils extracted from herbs and spices grown by the special crops program at CDCS were analyzed for flavor components by gas chromatography. Crops tested included dill, coriander, peppermint and spearmint. In support of the Western Canadian Potato Breeding Program, potato cultivars and selections were processed and evaluated for their french fry, boiling, baking and chipping quality. Total glycoalkaloid content of selected cultivars was also determined. Dry matter was determined on potato, carrot and onion varieties. The results will be used in selecting cultivars for commercial production and processing.

Technology Transfer Services

Staff from the food science and technology program participated in several technology transfer projects with Alberta companies, including the development a liqueur beverage formulation, evaluation of bread quality, improving pie filling viscosity, and improving post-harvest storage practices. Staff made numerous site visits to food processing companies in the province.

Forage Branch

Grass Seed and Forage Crops Program

H. Najda and A. Kruger

The grass seed and forage crops program at the CDCS is part of the Forage Branch located at the Lacombe Research Centre. The program conducts agronomic and adaptability research to provide up-to-date information on grass seed production and traditional forage crops. New crop species and varieties are submitted for testing by universities, provincial and federal research agencies and private industry from Canada, the United States and Europe. Research involving more than 100 irrigated and dryland experimental trials was conducted in southern Alberta, including CDCS and the Centre's substation at Bow Island.

Several trials were conducted in cooperation with other research institutions and agencies. These include the Forage Branch at Lacombe (forages), the Agriculture and Agri-Food Canada Research Station (AAFC) at Lacombe (forage corn) and the Alberta Research Council at Vegreville.

The following companies sponsored adaptability trials in 2000: Advanta Seeds Pacific (Oregon, USA); Alberta Research Council; Brett-Young Seeds (Man.); Cascade International Seeds (Oregon, USA); Cebeco International Seeds (Oregon, USA); Dawson Seed Co. (B.C.); Deutsche Saatveredelung (Germany); Lesco Inc. (Oregon, USA); Montana Turfgrass Technologies (Montana, USA); Newfield Seeds (Sask.); Northstar Seed (Man.); Parsons Seeds (Ont.); Peace Valley Seeds (Alta.); Pickseed (Ont.); Proven Seeds (Alta.); Scotts Co. (Oregon, USA) and Turf-Seed (Oregon, USA).

The program leader, H. Najda, provided information services to other AAFRD staff and producer and commodity organizations. Details of research trials are presented in *Grass Seed and Forage Crops Program Annual Report 2000*, CDCS Pamphlet 2001-9.

Research Projects

Perennial Forage Crop Studies

Perennial grass seed production under irrigation

This has become a major area of research in southern Alberta. Many seed companies from Canada, the United States and Europe are now contracting production in southern Alberta under irrigated and dryland conditions. Agronomy trials on tall fescue and perennial ryegrass were conducted at Brooks and Bow Island. These included companion cropping, fertilizer and dates of seeding trials.

In 1998, the Western Grass Seed Testing Program (WGST) was initiated to provide seed yield and adaptability information to the seed industry. The trials are coordinated by the grass seed and forage crops program at CDCS and are a cooperative effort of federal and western provincial research and extension staff and the seed industry. Testing sites are located at Fort St. John, British Columbia; Beaverlodge, Bow Island, Brooks and Vegreville, Alberta; Melfort and Saskatoon, Saskatchewan; and Arborg and Portage La Prairie, Manitoba. The grass seed and forage crops program at CDCS is responsible for seed acquisition and distribution to test cooperators and production of an annual report for seed producers and the seed trade. Species tested in 2000 included Kentucky bluegrass, smooth bromegrass, chewings and creeping red fescue, hard fescue, meadow fescue, mountain fescue, slender creeping red fescue and tall fescue, festolium, orchard grass, intermediate ryegrass, Italian ryegrass, perennial ryegrass, timothy, intermediate wheatgrass and blue wildrye.

Perennial forage variety testing

This was the tenth production year of this province-wide program evaluating perennial forage species and varieties. This program is funded by Alberta Agriculture, Food and Rural Development (AAFRD) and coordinated by the Forage Branch, AAFRD. Species tested include alfalfa, alsike and red clover, bird's-foot trefoil, cicer milkvetch, Kentucky bluegrass, smooth and meadow bromegrass, orchard grass, Italian and Westerwolds ryegrass, timothy and crested wheatgrass. The grass seed and forage crops program at CDCS is responsible for conducting irrigated and dryland trials at Bow Island and Brooks. The program is also responsible for compiling and analysing data from all the provincial sites and preparing the annual report for the Alberta Forage Variety Committee (AFVC) of the Alberta Forage Council. This testing program allows producers to base crop decisions on information from a wide range of forage varieties. Data have indicated that there are significant differences in variety performance for the different agro-climatic areas of the province. Results of the trials are now available to the producer in the updated Agrifax pamphlet *Varieties of Perennial Hay and Pasture Crops for Alberta*. Agdex 120/32. This information is also available on the internet at the AAFRD site <http://www.agric.gov.ab.ca/navigation/ crops/forage/index.html>.

The Western Forage Testing Program (WFT) was initiated in 1995. This is a cooperative tri-province (Alberta, Saskatchewan and Manitoba) venture which tests forage varieties for registration purposes. In most cases, enough location years are incorporated into the testing program to provide a basis for registration and to provide data for particular agro-climatic areas. In 2000, two alfalfa varieties and one crested wheatgrass variety were supported for registration by the AFVC.

Technology Transfer Services

The program leader, H. Najda, provided extension services to growers and industry personnel. In 2000, presentations were made at several industry and producer meetings and provincial advisory committees. Two information pamphlets on forage variety performance were updated. Najda participated on the Forage Product Team, the Alberta Forage Variety Committee, the Alberta Alfalfa Seed Committee, the Western Grass Seed Testing Committee, the Western Forage Testing Committee, and the board of the Chinook Applied Research Association. He also participated in seed judging for the North American Seed Fair held at Ag-Expo, Lethbridge.

Horticulture Unit

Entomology and Micropropagation Program

K. Ampong-Nyarko, K. Pruski, T. Lewis, N. Geschke and K. Fry (Alberta Research Council)

The objective of the entomology program, based at CDCN, is to develop and transfer functional integrated pest management (IPM) strategies for Alberta's horticultural industry that provide answers to insect pest control problems. It emphasizes biologically based IPM products, ecological principles, promotes minimized pesticide use, enhances environmental stewardship, and optimizes crop production and grower profitability. The program also seeks to strengthen the ability of growers to adopt and implement IPM practices. Research and extension are the key components of the program. The program investigates ways to control insect pests and manage beneficial insects by developing new tools and control options based on pest ecology, economic thresholds and forecasting systems. The program also evaluates and adapts narrow-spectrum insecticides and biological control agents. In 2000, research and development activities centered on the development of integrated pest management for root maggots in cole crops, and western flower thrips and lygus bugs in strawberries and saskatoons. The use of the biopesticide neem for the management of insect pests in greenhouses and organic crop production was also studied.

The micropropagation program at CDCN continued to maintain selections of native fruits in tissue culture for growers needing stock cultures for their own tissue culture labs. The program supplied four laboratories, (three in Alberta and one in British Columbia) with plant material for commercial production. Following is an inventory of fruit and ornamental species that was maintained in culture at the CDCN tissue culture laboratory in 2000:

Species	Cultivar
chokecherry	Garrington, Goertz, Robert, Lee Red, Yellow Boughen
mongolian cherry	#2, #4, Beaverlodge selections
nanking cherry	Black, White (Lee Orchard)
pincherry	Liss, Jumping Pound, Lee selections: #1, #2, #3, #4
saskatoon	Bluff, Buffalo, Forestburg, Honeywood, Lee #3, 5, 8, 10, 11, 12, Martin, Moonlake, Nelson, Northline, Pasture, Parkhill, Pembina, Quaker, Regent, Smoky, Success, Thiessen
sour cherry	Evans, Lutowka (Schattenmorelle)

Research Projects

During the winter, several media formulations were evaluated to improve existing protocols. It was determined that pincherry produces longer, healthier shoots with the addition of 1mg/L of gibberellic acid, GA_3 to the culture medium. Pre-rooted cuttings root well *ex-vitro* in small cell vegetable transplant trays when kept in a high humidity growth chamber. Rooted plants of new saskatoon selections were grown and will be planted in a test orchard in 2001.

Integrated pest management approach for controlling root maggots in cabbage crops in Alberta

The industry funded and AARI-matched cabbage root maggot project, done in collaboration with the vegetable program at CDCN, continued to address its goal of developing IPM for *Delia radicum* root maggots in cole crops. The project identified new information needs, including a lack of economic injury levels, thresholds for scouting, and computer models for predicting when root maggots will occur, therefore avoiding insecticide application by calendar. Degree-days of 220 accurately predicted the first appearance of root maggot flies in cabbage crops. Yields in the late planting were significantly lower than the early planting. Marketable weight in the untreated control was reduced by 16% in the early planting and by 36% in the late planting. The number of cabbage heads damaged by root maggots was also higher in late-planted and late maturing varieties. BotaniGard (*Beauveria bassiana*) proved to be a possible alternative to Lorsban for controlling root maggots in cabbage. BotaniGard-treated cabbage yield and percentage marketable heads (77%) were identical to Lorsban. The efficacy of promising root maggot IPM components, including BotaniGard, crop rotation, economic thresholds and Garlic Barrier, will be assessed in field trials with cooperating growers.

Control of tarnished plant bug and western flower thrips in strawberries and saskatoons

The objective of the project is to develop an effective IPM program to control tarnished plant bugs and western flower thrips in strawberries and saskatoons based on practical sampling methods, economic thresholds, narrow-spectrum insecticides and biological controls. In this first year, emphasis was placed on screening for narrow-spectrum insecticides and biological controls agents. Treatments tested were Matador (cyhalothrin-lambda), Thiodan (endosulfan), Agri-Mek (abamectin), Admire (imidacloprid), Actara (thiamethoxam) and Botanigard (*Beauveria bassiana*) Strain GHA. There were significant differences between treatments and the number of thrips at 14 days after application. BotaniGard provided better control than Thiodan, Avid and Admire and compared favorably with Matador and Actara. Data suggested that BotaniGard could be used effectively to control western flower thrips in strawberries, thus providing an alternative to the regular chemical insecticide treatment. The numbers of tarnished plant bugs were very low in all treatments.

Insect monitoring in bedding plant greenhouses

The monitoring of bedding plant greenhouses in the Edmonton area entered its third year. The common crops grown were fuchsia, Swedish ivy (hanging), coleus (hanging), begonia (plugs), begonia (mature), blue Felicia (hanging). Five yellow sticky traps per greenhouse were used. Monitoring as an insect pest management tool proved effective leading to 75% reduction in insecticide use. This project was undertaken jointly with the greenhouse crops program at CDCN.

Use of the biopesticide neem as a component of bio-intensive IPM for greenhouse crops

A new project using the biopesticide neem in greenhouse and organic crop production in Alberta received funding from the Alberta Market Gardeners Association, Alberta Professional Horticultural Growers Congress Foundation, and Pronatex Inc. The tree *Azadirachta indica*, commonly referred to in many countries as the neem tree, has insecticide properties. To date, over 450 species of insects belonging to 15 orders, as well as several species of mites and nematodes, are affected neem extracts. The broad-spectrum activity of neem (azadirachtin) at low use rates, coupled with the unique modes of action, make azadirachtin-based pesticides an ideal candidate for insecticide resistance management. The objectives of the project were to determine efficacy of neem extracts against mites, whiteflies, aphids, thrips and fungus gnats, and integrate it with other tools of pest management in greenhouse and organic crops.

Technology Transfer Services

Information on basic concepts of integrated pest management, root maggot IPM, and aster leaf hopper IPM was transferred to growers during presentations at industry meetings and workshops. The program also contributed articles on pest control to *Greenhouse Coverings*. In addition, the program answered general inquiries on specific grower concerns, such as insect identification and control options.

K. Pruski and T. Lewis provided extension advice to private tissue culture laboratories and to growers interested in establishing new laboratories. Consultations and problem solving were carried out via phone calls, fax and email. The micropropagation program provided one-on-one training and extension to one new laboratory in Alberta. Extension work was also carried out through publications in the scientific journals *Plant, Cell, Organ and Tissue Culture*, *In Vitro Cellular* and *Developmental Biology*.

Fruit Crops Program

L.G. Hausher and S. Dalpé

The provincial fruit crops program conducts adaptation and agronomic research in support of the developing and expanding berry and bush fruit industry in Alberta. Information generated from trials forms the basis of fruit crop recommendations provided to producers directly through producer organizations, and through Alberta Agriculture, Food and Rural Development staff.

Strawberries, raspberries, saskatoons and black currants are the major crops studied, although additional fruit crops are also evaluated for their commercial potential.

The majority of trials are conducted at the CDCS, with additional trials conducted at CDCN.

Details of all research trials are reported in CDCS Pamphlet 2001-6 *Fruit Crop Trials 2000*.

Research Projects

Strawberries

Four Junebearing strawberry adaptation trials were conducted to obtain production, quality and adaptability information on various cultivars and selections. Advanced strawberry selections from the Agriculture and Agri-Food Canada breeding programs at Kentville, Nova Scotia, and St. Jean-sur-Richelieu, Quebec were evaluated with information provided to breeders to assist in varietal release decisions.

A total of 25 cultivars and four selections were evaluated. Differences in production of three cultivars from two plant sources were also evaluated.

An overwintered day-neutral strawberry cultivar evaluation was conducted to obtain production, quality and adaptability information of three new cultivars as compared to industry standards.

Raspberries

Six new cultivars of floricane raspberries were grown and harvested to evaluate adaptability, production and quality information, as compared to three industry standard cultivars.

One new primocane cultivar was studied to access its acceptability and production potential in comparison to industry standards.

Saskatoons

Two well-established saskatoon cultivar orchards were rejuvenated in the spring of 1998 and 1999 by mowing to near the soil surface, and measurements made on regrowth, plant health, and fruit production.

Since many original commercial saskatoon orchards are in need of rejuvenation this information will provide techniques, orchard management, and post-rejuvenation yield response for these orchards.

Black Currants

A black currant adaptation trial was conducted to obtain production, flowering and fruiting patterns, quality and adaptability information on 14 cultivars. Plant material was obtained from Ontario, British Columbia and Pennsylvania. Additional cultivars were established in 1999 with plant material obtained from Scotland.

An agronomic study with black currants consisted of evaluating pruning methods on four cultivars.

Financial assistance from the Alberta Market Gardeners Association is appreciated and acknowledged in support of these black currant studies.

Gooseberries

Fifteen cultivars of gooseberries were evaluated to obtain production, quality and adaptability information. A feasibility study on gooseberry trellising was initiated.

Cherries

Mongolian cherry and chokecherry orchards were regenerated by mowing near ground level to evaluate regrowth and disease patterns in early spring 1999. In 2000, rows were narrowed and regrowth measured. Evans sour cherry was fruited to establish yield potential.

Technology Transfer Services

The program leader, L. Hausher, provided extension services to producers, producer organizations and Alberta Agriculture, Food and Rural Development staff.

Fruit Facts, a newsletter providing berry producers with up-to-date production and marketing information, was published monthly. Articles were prepared regularly for the Alberta Market Gardeners Association (AMGA) and the Fruit Growers Society of Alberta newsletters. A commercial berry production school was conducted in Edmonton in January and an Integrated Pest Management Workshop in March. Assistance was also provided with the Fruit Production Workshop in Edmonton in March.

Hausher continued as secretary and AAFRD representative to the Alberta Professional Horticultural Growers Congress and Foundation Society; the Alberta Horticultural Congress Foundation; The Horticultural Congress Planning Committee; The Alberta Society for Professional Horticultural Advancement; and the AMGA.

Presentations were made to research, commodity and advisory groups during the year. Assistance was provided in the planning and execution of the Alberta Horticultural Congress.

A Black Currant Research Openhouse was held at CDCS in July, 2000.

Financial assistance from the AMGA made it possible to attend the IV International Strawberry Symposium in Finland.

Hausher participated and became qualified as a trainer for the On-Farm Food Safety Program of the Canadian Horticultural Council.

Greenhouse Crops Program (Brooks)

J. Calpas, P. Coté, S. Graham, M. Konschuh, C. Toews, S. Lisowski and L. Puchailo

The greenhouse crops program at the CDCS serves southern Alberta's diverse greenhouse vegetable and floriculture industry through comprehensive extension and research programs.

Research in new crop development, new technology and improved crop production techniques, are the main components driving the applied research program. The basic research program is directed towards reducing the negative environmental impacts of greenhouse crop production. Basic research is currently being conducted on the development of biological controls for *Botrytis cinerea, Pythium* spp. *Rhizoctonia solani* and *Fusarium* spp. in greenhouse crops.

Research undertaken by the greenhouse crops program has a strong market-driven focus, working with industry greenhouse produce marketers, to improve the entry of Alberta products into proven and developing markets across Canada and the U.S.

The program has identified market opportunities and has worked to improve the Alberta industry's access to these opportunities including cluster and beefsteak tomatoes, and increasing market demand for greenhouse vegetables grown with reduced pesticide inputs.

Research crops are grown to approximate commercial greenhouse crops and attain commercial levels of production. Greenhouse research projects target the distinct Alberta greenhouse growing environment and provide information on the best use of inputs and crop handling techniques specifically for Alberta conditions.

A number of trials are conducted in close association with grower organizations and industry partners. These include the Red Hat Cooperative, Air Liquide Canada, Westgro Horticultural Supplies Ltd. and Applied Bio-nomics Ltd. Trials are also conducted in cooperation with other department units and provincial government agencies, as well as educational and research institutions, including the Pest Management and Prevention Unit (AAFRD), Department of Environmental Protection and the University of Alberta.

Research trial reports are presented in *Greenhouse Coverings*, the greenhouse crops program monthly newsletter, which is also available on the internet.

The program leader, J. Calpas, provides information and expertise to other AAFRD staff, allied industry, financial institutions, community planners and to grower organizations.

Research Projects

Efficacy of precision placement carbon dioxide supplementation in greenhouse sweet pepper and beefsteak tomato production

The efficient use of carbon dioxide supplementation in Alberta greenhouse vegetable production represents a significant opportunity to increase yield. This project was initiated in 1998.

The project is a cooperative effort between the greenhouse crops program, the Red Hat Cooperative and Air Liquide Canada and received matching funding from the Alberta Agricultural Research Institute. This was the third and final year for the project. This year was also the first that greenhouse beefsteak tomatoes were included.

The focus of the project was to design a carbon dioxide supplementation system to improve the distribution of carbon dioxide within the plant canopy and define the parameters that allow for cost-effective carbon dioxide supplementation under southern Alberta greenhouse growing conditions.

The result was a 40 per cent yield increase in beefsteak tomatoes and a 30 per cent increase in sweet peppers represents an unprecedented increase in yield potential for Alberta growers.

Development of crop diversification opportunities for Alberta greenhouse growers

Crop development work in 1999 focused on cut flowers. Work was initiated on determining the cultural requirements and performance of Physotegia (obedient plant), Lysimachia (gooseneck loosestrife) and Chinese cultivars of Lysianthus. These trials will continue into 2001-2002.

Development of biological controls for greenhouse crop diseases

The greenhouse crops program has a long-standing commitment to biological controls. Research vegetable crops have been grown without the use of pesticides for six years running. This commitment reflects the overall commitment of the Alberta greenhouse industry towards the use of biological control agents for greenhouse pests.

In addition, developmental work on biological control agents for common greenhouse diseases has been ongoing over the past year. Work has primarily targeted the gray mold pathogen, *Botrytis cinerea*, using Alberta isolates of *Trichoderma* spp., a fungal genus known for its activity against disease-causing fungi. Two very promising isolates have been selected and an industry partner is being sought for registration and development of a commercial biocontrol product.

New projects to develop biological controls against the common root pathogens *Pythium* spp., *Fusarium* spp. and *Rhizoctonia solani* have been expanded.

The bulk of funding for the *Botrytis* project was provided by the Alberta Agricultural Research Institute.

Application of genetic fingerprinting technology

Through the biological control program the greenhouse crops program has developed considerable expertise in the genetic fingerprinting of fungi and other organisms. Two independent projects initiated in 1999 continued through this year. These projects were in cooperation with Pest Management and Prevention Unit (AAFRD), and the Department of Environmental Protection. The objectives of the projects were to develop rapid DNA-based identification procedures for the European elm bark beetle and the mountain pine beetle which could be used on partial specimens and to determine whether individual beetles could be identified with respect to "regional" parent populations of the beetles.

One new project initiated in 2000 is working on the genetic characterization of fungicide resistant strains of *Alternaria solani*, the early blight of potato pathogen.

Technology Transfer Services

The program leader, J. Calpas, provided extension service to growers and department and industry personnel. Telephone and on-site consultations with greenhouse growers regarding crop management concerns and problems comprise a large part of the extension activities. Transferring crop production expertise regarding new crops and improved production techniques and technology is also a strong component of the extension service.

Several presentations were delivered at industry and producer meetings.

A *Guide to Commercial Greenhouse Sweet Pepper Production* was completed and is in press; it has also been posted on AAFRD's internet site.

Calpas also provided information to other department staff; Rural Development Specialists and Marketing Specialists, as well as departmental committees and the Horticultural Product Team. Consultations with loan officers with private banks and the Agriculture Financial Services Corporation are also routine.

The greenhouse crops program also has a grower training program, which provides hands-on crop management and production training to individuals interested in becoming commercial growers. This program has produced growers who have gone on to become established owner/operators of successful commercial greenhouse businesses.

Calpas continued as a full-time student in a Ph.D. program through the University of Alberta.

Greenhouse Crops Program (Edmonton)

M. Mirza, M. Younus and W. Chen

Alberta Greenhouse Growers Association (AGGA) completed an extensive survey of the greenhouse crops industry in the province with funds made available by the Agri-Food Council, AGGA and AAFRD. This was the first survey where nearly 360 growers in the province were visited and information was gathered on various aspects of the industry. There are 270 acres (109 ha) of greenhouse production in Alberta, an increase of almost 90 per cent during the last decade.

The most significant factor, which is going to affect the future growth of the industry is a very rapid increase in the price of natural gas, the most commonly used heating fuel. Heating costs as a part of greenhouse operating costs vary from 20 to 40 per cent, depending on where the greenhouse is located. Two workshops were organized by the AAFRD, AGGA and Alberta Research Council staff. One hundred and eighty-seven growers were provided information regarding various aspects of energy conservation, alternative fuel sources, possibilities of using heat from co-generation and how to increase yields. Many growers switched over to coir as a growing medium.

Thom Rypien from Olds College spent his sabbatical leave at CDCN. He worked on developing protocols for organic fertilization of greenhouse crops. This cooperative venture resulted in a comprehensive research report and established a bench mark for future cooperation.

Research Projects

Possibility of winter production of tomatoes

Cultivar Campari was seeded the third week of October and transplanted into 26 L volume sawdust bags the first week of December at a density of 2.5 plants/sq.m. Standard greenhouse temperature and fertilization cultural practices were followed. The plants were topped off at the fifth cluster. The first marketable fruit was harvested January 25, 96 days from seeding; the last fruit harvest was March 20, for a total of 57 days. Campari is a cluster variety but the fruit was harvested individually. The total harvest was 3.8 kg/m^2 . The average fruit weight was 61.6 grams. At an average price of $5.00/kg, the total gross revenue potential was at $19.00/sq.m. The results of this trial suggested that smaller fruited cultivars can become a viable crop for winter production.

Effect of three seedling transplant practices on the yield of tomatoes

Cultivar Trust was grown in 10 cm rockwool blocks and transplanted into sawdust bags using three placement methods. The objective was to determine the effect of these practices on the total yield of the crop and to observe root development. The commercial practice is to place the blocks on the surface and let roots develop into the growing medium. When plants are lowered the contact is easily broken, resulting in a stress to the plant. In one treatment the blocks were placed on the surface of sawdust, the second were half buried and the third were completely buried. There were no significant differences in yield between treatments. Root development was higher in treatments where blocks were completely buried; the plants were easier to lower in this treatment, and there was no root breakage.

Effect of three seedling transplant practices on the yield of seedless cucumbers

Cultivar Sabrina was seeded the first week of April and transplanted the third week of April in sawdust bags. The blocks were either completely buried in sawdust, half buried or placed on the surface. Yields of marketable fruit was recorded for 10 weeks. The yield from plants where the blocks were placed on the surface was 14.8 kg/m^2, 16.2 kg/m^2 where blocks were completely buried and 16.8 kg/m^2 where blocks were half buried. The yields were not significantly different at 5 per cent level of probability. The root development appeared to be better in plants in which the blocks were completely buried. Many commercial growers will adopt this practice in 2001.

Evaluation of *Paenibacillus polymyxa* PKB1 for biocontrol of Pythium of cucumbers in hydroponics systems

In cooperation with J. Yang and P.D. Kharbanda, Alberta Research Council, Vegreville, studies were continued for a second year to evaluate the ability of *Paenibacillis polymyxa* PKB1 to protect cucumber plants against *Pythium* spp. in vitro and in a sawdust growing system. In the in vitro test, *P. polymyxa* PKB1 showed inhibitory effect against nine *Pythium* strains isolated from cucumber roots on potato dextrose agar and nutrient agar plates. *P. polymyxa* PKB1-coated cucumber seeds had significantly higher germination and survival rate rates than uncoated seeds when tested against *Pythium* spp. on water agar plates. In the greenhouse tests, *P. polymyxa* was added at the rate of 1x10^6 spores/ml in a recycled and non-recycled nutrient solution system. *P. polymyxa* could survive in the nutrient solution and significantly reduced the disease severity of cucumber plants in both systems. The yield of bacterium treated cucumber plants was significantly higher than those of *Pythium*-treated or untreated control plants.

In the treatment containing *P. polymyxa* PKB1 alone without *Pythium* inoculant, the bacterium also protected the plants from natural infections by fungi and the cucumber plants had higher yield. The results of the present study demonstrated *P. polymyxa* PKB1 has a potential to be used as a biocontrol agent in greenhouse cucumber industry.

Effect of calcium supplementation on the growth of geraniums

The objective of this study was to demonstrate calcium fertilization as a regular part of a feeding program will have a beneficial effect on the growth of geraniums. Many growers will use fertilizers with no calcium, assuming there is enough present in water. Seven-week-old seed geraniums cv Orbit Cherry were obtained from High-Q greenhouses, Morinville, AB. Plugs were transplanted into 15 cm azalea pots in a commercial pro-mix growing medium. Three weeks after transplanting, the plants were split into two groups. One set of 36 plants was split into six replicates with six plants in each replication. This set of plants was fertilized with a commercial blend of 20-20-20 fertilizer with no additional calcium. The other set of 36 plants received an additional 50 ppm of calcium from calcium nitrate. Nitrogen levels were the same in both groups. The study was terminated when plants were 15 weeks old and flowering. Fresh and dry weights and tissue analyses of both roots and shoots were conducted. Statistical analysis was done using a SAS program and significance was determined at 5 per cent level of probability.

The results indicated a significant difference on fresh weight basis between the shoots of both treatments. The average fresh weight was 134 grams in the plants which received additional calcium as compared to 117 grams in the non-calcium treatment. All other weights were non significant. The calcium levels in the tissue of the plants receiving additional calcium was 1.2 per cent compared to 1.08 per cent in the tissue of those receiving no additional calcium. Geraniums should be fertilized with additional level of calcium to obtain better quality plants.

Evaluation of an organic fertilizer to produce *Echinacea angustifolia* plugs

Echinacea angustifolia was germinated the third week of January and transplanted to 128 bedding plant plug trays containing a commercial soilless mix. This treatment received a standard complete inorganic fertilizer solution twice a week and served as the control. A granular organic fertilizer, 6-2-4, was incorporated into the same soilless mix at a rate of 1 or 3 g/L and served as two treatments which did not receive any inorganic fertilizer. There were three trays in each treatment, each tray containing 128 plants was considered a replicate. Two treatments with the pre-incorporated 6-2-4 fertilizer received two additional toppings of 6-2-4 in March and April at a rate of 30 grams/tray. The pH and E.C. was monitored weekly. Seedlings were harvested the second week of May. Fresh and dry weights were determined.

There was no significant difference in fresh and dry weights between three treatments at 5 per cent level of probability. In conclusion, the use of the organic fertilizer 6-2-4 resulted in a good quality *E. angustifolia* plug when compared to an inorganic fertilizer.

Effect of nitrogen fertilization on the biomass yield of Gotukola (*Hydrocotyl asciaticum*)

Gotukola (*Hydrocotyl asciaticum*) cuttings were rooted the first week of March and transplanted in 4 litre nursery pots the first week of April. On May 3, the plants were divided into two groups, one received nitrogen at 100 mg/L, the other was supplied nitrogen at 200 mg/L. Leaves were harvested in May, June, July and September and the fresh and dry weights of the two treatments were compared. The biomass from plants receiving nitrogen at 200 mg/L was significantly higher than the plants receiving nitrogen at 100 mg/L.

Effect of organic fertilizer applications on Echinacoside levels in field produced Echinacea angustifolia

M. Mirza, Y. Hyano, Food Safety Div., AAFRD and T. Rypien, Olds College evaluated the use of two certified organic fertilizers in a commercial field planting of *E. angutifolia* in a sandy loam soil. A soil test indicated very low levels of most nutrients. Fish Agra 4-1-1 and 6-2-4 certified organic fertilizers were applied in 3-metre rows on 2 or 3 year-old plantings of *E. angustifolia*. The amounts applied were equivalent to provide 30 kg of nitrogen/ha. The fertilizers were applied in June and roots were harvested in October after plants had been exposed to three frosts. There were six rows in each treatment, each row being considered as one replicate. The rows were randomized throughout the field. Control plants did not receive any fertilizer. The fresh roots were shipped to the laboratory where they were washed and freeze-dried for echinacoside analysis using a HPLC. The echinacoside analysis was conducted on six randomly selected samples in duplicate. The cost of analysis prohibited the testing of each replicate. Roots harvested from plants which received no fertilizer showed an echinacoside level of 0.73 per cent while all the other treatments showed a level of ranging from 0.82 to 0.96 per cent. The highest level of echinacoside was recorded in a third year planting which received 6-2-4 granular fertilizer application.

Evaluation of organic fertilizers for the production of three species of Echinacea

Echinacea angustifolia, E. pallida and E. purpurea were grown in a soilless media which was amended with an organic fertilizer 6-2-4 at a rate of 3 g/L, or grown in the same media and fertigated with Fish Agra 4-1-1 or a standard inorganic fertilizer which served as a control. Each fertilizer treatment was replicated four times, there were 15 plants in each treatment. Eight week-old plugs were planted into the growing media the third week of March and roots were harvested the third week of November. Fresh weights of roots and shoots were determined. Echinacoside analysis was carried out on air dried roots using HPLC. In the case of *E. purpurea* the biomass data was collected only on the shoots and flowers. There were no significant differences in the dry weights of roots when fertilizer treatments were compared both in *E. angustifolia* and *E. pallida.* The echinacoside level in the case of *E . angustifolia* roots was 1.92 per cent in control plants as compared to 1.71 per cent in the plants fertilized with 6-2-4 and 2.16 per cent in

the plants fertilized with Fish Agra 4-1-1. The echinacoside level of *E. pallida* roots was 1.51 per cent in plants from control treatment, 1.15 per cent in plants fertilized with 6-2-4 fertilizer and 1.5 per cent in plants receiving Fish Agra 4-1-1.

The biomass differences of *E. purpurea* grown on three fertilizers were not significant, leading to conclusion these three species of Echinacea can be grown using organic fertilizers.

Evaluation of several organic fertilizers on the growth of greenhouse grown plants

M. Mirza and T. Rypien, Olds College, conducted several experiments to determine the suitability of different organic fertilizers to grow many greenhouse crop seedlings. In one trial, three fertilizers, Fish Agra 4-1-1, Wegeners 8-6-6 and a blend of 20-20-20, were used to fertilize cabbage, cucumber, tomato and lettuce seedlings at equal nitrogen levels. The plants were grown in bedding plant plug trays. The seedlings were grown for six weeks and then fresh and dry weights of roots and shoots were determined. The seedlings which received 20-20-20 or 8-6-6 fertilizer had significantly higher root and shoot weights when compared to plants which received Fish Agra 4-1-1 fertilizer. There were also significant differences in tissue nutrients when the above treatments were compared.

In a second experiment, the effect of organic nitrogen from seven sources was evaluated using cucumber as a model plant. Steamed bonemeal (3-15-0), blood meal (14-0-0), feather meal (14-0-0), blood and feather meal mix 1:1 ratio, canola meal (6-2.5-1) and bradfield alfalfa meal (3-0-5) were pre mixed with a commercial organic soilless growing medium to provide an equivalent amount of 200 mg of nitrogen in one litre of the mix. The cucumber seedlings were grown for six weeks and fresh and dry weights of roots and shoots were determined. The highest fresh and dry weights of roots and shoots were obtained in plants which received nitrogen from canola meal, followed by alfalfa, feather, blood-feather meal and blood.

In a third experiment, six sources of organic phosphorus were evaluated using tomato seedlings as a model. Steamed bonemeal (3-15-0), fishbone meal (5-22-1), rock phosphate (0-27-1), Howkins Black Gold (0-12-0) bonemeal (0-14-0) and bat guano (4-10-1) were incorporated with an organic soilless mix at a rate to provide equal amount of phosphorus. Tomato seedlings were harvested after six weeks and root and shoot fresh and dry weights were determined. The best biomass was obtained in plants grown in media incorporated with steamed fishbone and bone meal indicating phosphorus from these two sources is available to the plant at early stages of development.

In a fourth experiment, an organic fertilizer 6-2-4 was incorporated with a commercial organic soilless medium at a rate of 1,2,3,4 and 8 g/L and tomato plants were grown in this medium for six weeks. The plants grown in the medium with 4 g/L of 6-2-4 achieved the highest biomass development and no nutrient deficiencies observed.

Technology Transfer Services

Greenhouse planning and production information was provided to over 200 growers. Practical tips on greenhouse crops management was provided through workshops and a field day. *Greenhouse Coverings* continued to be a significant tool for information transfer. Staff were involved in guest lecturing at the University of Alberta. M. Mirza was a guest speaker at conferences in United States. Program staff were involved in supervising an in-depth greenhouse industry survey conducted by the Alberta Greenhouse Growers Association. The support received from Economics Services of Economics and Competitiveness Division of AAFRD to document the impact of increased price of natural gas on the cost of production was greatly appreciated.

Horticulture Industry Development

B. Vladicka, S. Demers Collins

The objectives of this program area are to:

- facilitate the development of markets for Alberta horticultural products
- provide assistance to the industry to improve its competitive position
- facilitate the adoption of on-farm food safety by horticultural producers
- administer the Farmers' Market program across the province.

The organic industry in Canada is valued at one billion dollars and is growing at the rate of 20 to 25 per cent per year. AAFRD has undertaken a number of activities to assist organic producers within the province. As part of a multi-disciplinary team, numerous workshops were given across the province to inform producers about the organic industry and the transition to organic production. Vladicka is a member of the certification committee for Organic Crop Improvement Association Alberta #1 and was a member of the pilot certification committee for the Canadian Organic Advisory Board Secretariat that is overseeing the implementation of the national organic standards. Vladicka is also a member of the department's organic business development team.

The guidelines for the Alberta Farmers' Market program were revised by a stakeholder review committee and approved by the Minister, effective April 1, 2000. The new guidelines stress the "make it, bake it, grow it" concept of markets and clearly define the roles and responsibilities of the sponsoring body for the market, market manager and market vendors.

In 2000, there were 120 approved farmers' markets operating in Alberta. Each year, a brochure listing all the approved markets is produced and distributed across the province. Program guidelines and a listing of all markets are available on AAFRD's website at <www.agric.gov.ab.ca/navigation/food/consumer/index.html>.

Simone Demers Collins is the Farmers' Market Administrator and is an ex-officio member of the board of directors of Alberta Farmers' Market Association. Assistance was provided to the association in planning their annual meeting, general management of the association and the development of a business plan. Demers Collins was invited to speak to a gathering of farmers' market managers in British Columbia.

Increased efforts were undertaken to promote direct marketing as an alternative means of accessing the market place. Vladicka participated in several workshops that were targeted at producers who were new to this marketing method. Vladicka chaired a multi-disciplinary team that initiated this approach. Other activities included the development of a direct marketing newsletter, working with Alberta Infrastructure to improve highway signage for rural businesses and planning a conference which will take place in February 2001.

The Fruit Growers of Alberta promoted fresh fruit through two major initiatives. The second annual Saskatoon Berry Festival was held in late July at the U of A Devonian Botanic Garden. Public support was very positive and the participating growers were pleased. The Association also produced the Prairie Fruit Guide, a directory of members with farm gate sales of fruit.

In order to maintain consumer confidence in the quality of fresh fruits and vegetables, the Canadian Horticulture Council (CHC) developed standards for on-farm food safety that can be implemented by growers. To facilitate the implementation of these standards, CHC arranged for train-the-trainer sessions across Canada. Vladicka coordinated the Alberta workshop which was attended by nearly all the horticulture production specialists and some staff from the Food Safety Division. Throughout the year, a number of presentations were given to raise the awareness of producers about these standards. In April, Vladicka was seconded on a half-time basis to the Food Safety Division within AAFRD to facilitate the adoption of these standards by Alberta producers.

Vladicka was a member of the team that hosted the Ag Summit workshop on food safety. This workshop was one of many that were held as part of the Ag Summit consultative process. The information generated at the workshop was forwarded to the Ag Summit wind up meeting where recommendations were developed to advance the agriculture industry.

Vladicka has also been an active member of the Horticulture Product Team. The product team is a multi-disciplinary group that fulfills an integrating mechanism in the department's planning function. It addresses issues and opportunities facing the horticulture and apiculture industries in Alberta by consulting with the different sectors in the industry.

Nursery Crops Program

C.L. Murray, N.G. Seymour and T.T. Pheh

The nursery crops program is focused on research into cultural management practices for commercial nursery production of both field and container-grown plants and the evaluation of new plant cultivars. Technology transfer activities included seminar presentations, magazine articles and research reports which are directed to growers and other members of the nursery-landscape trades industry as well as potential growers. A close association with Landscape Alberta Nursery Trades Association (LANTA) allows for excellent communication with the commercial industry.

C.L. Murray, program leader and N.G. Seymour, nursery crops technologist are based out of CDCS and T.T. Pheh, nursery crops technologist is based out of the CDCN.

The program leader also provides information services to other AAFRD staff and to producer and commodity organizations. Details of research trials are presented in *Nursery Crops Program 1999*, CDCS Pamphlet 2000-8.

Research Projects

Woody Plant Evaluation Trials

Prairie regional trials — CDCS and CDCN

The Prairie Regional Trials (PRT) were established in 1958 to evaluate the hardiness of woody plants on the Canadian Prairies and continue today in cooperation with Agriculture and Agri-Food Canada, Morden Research Station, Morden, Manitoba. The plants in the PRT are evaluated for five years at eight prairie sites including CDCS and CDCN. The growth and landscape quality data collected each year are sent to Morden where a report is produced approximately every three years and is now available at the following internet website <http://res2.agr.ca/winnipeg/prt59_58.html>. In 2000, nine new selections were planted at CDCN and six were planted at CDCS.

Regional woody plant test program — CDCS AND CDCN

Since 1983, Alberta Agriculture staff and the LANTA Growers Group and Research Committees have cooperated to develop and maintain The Regional Woody Plant Test Program (RWPTP). New tree and shrub introductions, generally from North America, are evaluated for five years at seven different sites representing different climatic regions in the province. Growth and landscape quality data are collected each year. Seven new selections were planted at the eight sites in 2000.

For more information about the RWPTP from 1983-1998 see *Regional Woody Plant Test Project, Summary Report 1998, CDCS Pamphlet #99-26* or on the internet at <http://www.agric.gov.ab.ca/crops/trees/rwptp/index.html>.

The University of British Columbia plant introduction program — CDCS

The University of British Columbia (UBC) Botanic Garden Plant Introduction Program selects superior plant material from many sources to test for suitability for introduction into the nursery-landscape industry. In 1998, the UBC selection, *Lonicera* 'Son of Mandarin', began evaluation at CDCS. For more information on the UBC program go to <http://www.hedgerows.com/UBCBotGdn/UBCResearch.html>.

The perennial trial garden at the Calgary Zoo

In response to the huge growth in interest and sales of herbaceous perennials, the Calgary Zoo and Botanic Garden, LANTA Retail Operators Commodity Group and Alberta Agriculture cooperated to develop the perennial demonstration and evaluation garden in 1999 for a three year trial period. The garden is located at the Calgary Zoo in the Dorothy Harvie Gardens. The project objectives are: 1) to evaluate new species and cultivars of perennials for hardiness and landscape quality under Chinook conditions; 2) to compile and publish the results for the public, retailers, growers and landscape professionals; 3) to increase the knowledge about new perennials for the public, retailers, growers and landscape professionals; 4) to provide a unique work experience at a public garden for a horticulture student.

All-America selections — CDCS

All-America Selections is a non-profit organization dedicated to promoting the development and introduction of improved cultivars of flowers and vegetables. The CDCS location is one of the approximately 35 trial sites in North America. The results of the evaluations from all the sites are tabulated and the best selections are released 18 months later. In 1999, nine new selections were evaluated.

Bur oak provenance trial — CDCN

The Bur Oak Provenance Trial is a cooperative trial originally organized by the Great Plains Agricultural Council, Forestry Committee and is coordinated in Canada by the Prairie Farm Rehabilitation Administration (PFRA) Shelterbelt Centre, Indian Head, Saskatchewan. The objectives of the project are: 1) to determine the nature and extent of bur oak genetic variation; 2) to provide genetically improved bur oak seed for shelterbelt planting; 3) to provide germplasm that can be used for selection and trait improvement as well as advanced-generation breeding; and 4) to survey the distribution and impact on seed quality of *Curculio* spp. (acorn weevil). The project began in 1993 and is expected to run for approximately 20 years. There are 48 accessions in the trial collected from the following locations: Manitoba (19), Saskatchewan (4), Minnesota (4), Montana (3), North Dakota (16), South Dakota (2).

Vineland apple rootstock trial — CDCN

The Vineland Apple Rootstock Trial is a cooperative trial with the University of Guelph, Horticultural Experiment Station, Simcoe, Ontario. The trial is evaluating the cold hardiness of the "V" series of rootstocks. There are currently four selections for the control (Ottawa 3, M9, Beautiful Arcade, Columbia) and five new selections bred at the Simcoe Station. The trees were planted in 1997 and will be on trial for five years.

Production Management Research Projects

Investigation of the growth of two species of field-grown trees at different nitrogen fertilizer rates — CDCN and CDCS

Field-grown plant material is the largest segment of the nursery industry in Alberta. There is inadequate information about the management of fertility for maximum tree growth in the short Alberta growing season, while avoiding over fertilization which may result in winter kill or dieback of trees. Colorado blue spruce seedlings and Summit (Edmonton) and Patmore (Brooks) green ash were planted on an unirrigated site in Edmonton and an irrigated site near Brooks and grown at four soil nitrogen (N) levels: control (no added fertilizer), 50, 90 and 130 kg N/ha.

There were no significant differences in tree caliper increase for spruce and ash over the season, in 1997, 1998, 1999 or 2000, except for three occasions: spruce 1997 in Brooks where caliper change was greater in the control and at 50 than at 130 kg N/ha, spruce 2000 in Edmonton where caliper change was greater at 50 kg N/ha than the control and ash in 1999 in Edmonton, where caliper change was greater at 50 and 130 than at 90 kg N/ha. Tissue N content was not different for ash in 1998, 1999, 2000 or spruce in 1998 or 1999. In 2000 spruce tissue N was greatest at 90 kg N/ha.

Evaluation of the effect of IBA concentration and timing on rooting efficiency for softwood cuttings of six species of woody plants — CDCN

A number of species of shrubs are considered by growers to be difficult-to-root using softwood cuttings and this limits their availability in the marketplace and increases the cost of production of these species.

Cuttings of new green shoots were collected on three dates from mature Saskatoon, beaked hazelnut, seabuckthorn, pin cherry, Royal Purple lilac and Chickadee birch. Seabuckthorn cuttings rooted well, between 95 and 98 per cent and Saskatoon and beaked hazelnut rooted well with cuttings collected on June 28, with 80 and 76 per cent rooting, respectively. The other species all had poor rooting, less than 50 per cent, in all rooting hormone treatments and at all three dates.

Evaluation of induced juvenility on the rooting efficiency for softwood cuttings of two species — CDCN

The literature indicates that some hard-to-root woody plants have better rooting efficiency when the cuttings are collected from juvenile plant material. For this experiment, cuttings were collected from a 15 year old stand of pin cherry and 20 year old stand of 'Smoky' Saskatoon. Juvenile cuttings were collected from mature plants cut down to ground level in early May 2000 then allowed to grow. Juvenile pin cherry and Saskatoon cuttings, rooted at 93 and 97 per cent, respectively, compared to 29 and 62 per cent rooting, respectively from mature plants.

Altering the medium pH of container-grown woody plants utilizing various sulphur products and rates — CDCS

The medium used for container-growing woody plants is generally a soilless or low soil product with a low buffering capacity, so the pH of the medium is highly influenced by the quality of the irrigation water. Plant growth and quality are affected by high pH (above 7.5). Sulphur products can be used to reduce the pH of the container medium but little information exists on the rates required to reduce the pH or the affect on medium pH throughout the growing season.

Rooted cuttings of Goldflame spiraea and Scot's pine seedlings were grown in #2 containers with three sulphur products: elemental sulphur (0-0-0-95), Tiger 70 (6-0-0-70) and Tiger 90 (0-0-0-90) incorporated into the container medium at four rates: 0.45, 0.90, 1.35 or 1.80 kg/m^3. Plants in the control treatment had no sulphur added to the medium. There were no significant differences in dry weight in the pine or the spiraea as a result of the different S types or rates applied in 1999. In 2000 the pine caliper and growth index were smallest with elemental S and there were no differences at the different S rates. For spiraea there were no differences in growth index or dry weight as a result of the different S rates or types. The S rates and types had no impact on the medium pH in 1999 or 2000.

An investigation of the impact of high rates of sulphur on the medium pH of container-grown woody plants — CDCS

Rooted cuttings of Goldflame spiraea were grown in #2 containers with three sulphur products: elemental sulphur (0-0-0-95), Tiger 70 (6-0-0-70) and Tiger 90 (0-0-0-90) incorporated into the container medium at four rates: 3.6, 5.4, 7.2 or 10.8 kg/m^3. Plants in the control treatment had no sulphur added to the medium.

There were no significant differences in plant dry weight as a result of the different sulphur treatment. The pH of the media was highest at 10.8 kg S/m^3 with elemental S and Tiger 90 and lowest at Tiger 70 at 3.6 kg S/m^3 and Tiger 90 at 7.2 kg S/m^3.

Plant collections CDCS and CDCN

Plant collections have been developed and maintained at both CDC South and North as a living reference collection for use by horticultural professionals and the general public. The **Golden Prairie Arboretum** was established in 1981 at CDCS. The collection now contains 312 species of 68 genera for a total of 531 deciduous trees and shrubs. These plants represent most of the deciduous woody plant species that can be grown on the prairies. A complete listing of the collection is available in *Golden Prairie Arboretum, ASCHRC Pamphlet 93-1.* The **Forever Green Pinetum** collection of coniferous trees and shrubs at CDCS was established in 1986. At present it contains 26 species of nine genera for a total of 120 trees and shrubs. A complete listing of the collection is available in *Forever Green Pinetum, ASCHRC Pamphlet 93-12.* The **Rose Garden** contains 241 specimens, many of which are unique to the CDCS collection. Many early Canadian rose cultivars and notable crosses of Canadian rose breeders, Skinner, Bugnet and Wallace are maintained in the collection. At CDCN, the **McCalla Arboretum** has 192 taxa on display and is being redesigned as a lower maintenance landscape.

Technology Transfer Services

Technology transfer to the growers is accomplished through work with the LANTA Growers Group, Western Nursery Growers Group, nursery visits as well as by the production and distribution of the Nursery Crops Trial Report, magazine articles and the presentation of seminars. In 2000 the Nursery Crops Group hosted a research open house at CDCS.

Plant Pathology Program

P.S. Bains, H.S. Bennypaul, M. Yu and V. Kanrek

The plant pathology program at CDCN in Edmonton conducts research and provides technology transfer services to reduce losses caused by various diseases of horticulture and special crops. The program develops research projects and has been successful in obtaining research funds for many of these projects from private and government agencies. The program has published many research papers in refereed and non-refereed journals, research reports, and articles in industry and government newsletters. Results of various research projects have also appeared in newspapers, magazines and in media interviews.

Research Projects

Outstanding research paper award nomination

Bains, P.S., V.S. Bisht, D.R. Lynch, L.R. Kawchuk and J.P. Helgeson. 1999. Identification of stem soft rot (*Erwinia carotovora* subspecies *atroseptica*) resistance in potato. American Journal of Potato Research 76:137-141, was one of the six research papers selected by the seniors editors of the journal for Outstanding paper award for 1999. The selection was announced at the 83rd Annual Meeting of the Potato Association of America, July 23-27, 2000, Colorado Springs, Colorado. The research project yielding this paper was in cooperation with scientists from Agriculture and Agri-Food Canada, Lethbridge, and University of Wisconsin, Madison. The project was funded by a direct research grant from Alberta Agricultural Research Institute.

The paper identified 65 resistant or highly resistant clones of wild *Solanum* species and described three tuber soft rot-resistant clones that are also resistant to stem soft rot. The resistant clones identified in this study are being used to develop soft rot-resistant cultivars of potatoes at the Agriculture and Agri-Food Canada, Research Centre, Lethbridge.

Identification of fungicides for control of cytospora canker, brown rot, and blackleaf and witches' broom diseases of saskatoon

This research project is funded by Fruit Growers Society of Alberta, Alberta Horticultural Congress and Alberta Agricultural Research Institute (AARI), and is in cooperation with Dr. R.J. Howard, CDCS.

Cytospora canker — *Fungicide screening by in vitro radial growth inhibition of Cytospora leucostoma.* Of 12 fungicides, thiophanate-methyl (Senator) and chlorothalonil (Bravo) at 1 ppm (the lowest concentration tested) caused complete inhibition of *in vitro* radial mycelial growth of *Cytospora leucostoma*, the cause of cytospora canker disease of saskatoon. Iprodione (Rovral) and propiconazole (Topas) caused the similar inhibition at 10 ppm, whereas, captan (Captan), tebuconazole (Elite), Benomyl (Benlate), and triademefon (Bayleton) produced similar results at 100 ppm.

Fungicide screening by detached shoot bioassay. An experiment was designed using detached saskatoon shoots to observe the effect of fungicides on *Cytospora* infection. Propiconazole and chlorothalonil significantly inhibited the infection. Fludioxonil (Medallion) had no effect on infection. Effective fungicides will be evaluated in commercial saskatoon orchards for control of cytospora canker disease of saskatoon.

Brown rot — *Laboratory experiments:* *In vitro* experiments were conducted to determine the effect of fungicides on mycelial growth of *Monilinia amelancheiris*, the cause of brown rot and witches' broom of saskatoon. Tebuconazole, thiophanate-methyl, benomyl, fenbuconazole (Indaar), fludioxonil, and propiconazole completely inhibited growth of the pathogen at 1 ppm, whereas, myclobutanil (Nova) and iprodione caused complete inhibition at 10 ppm. Captan, chlorothalonil, sulphur (Kumulus), and azoxystrobin (Quadris) were unable to inhibit the growth at 100 ppm, the highest concentration tested.

Field experiment: Six fungicides, based on *in vitro* results and present registration on saskatoon, were evaluated for their ability to control the disease in four commercial saskatoon orchards in Alberta. The disease in the orchards ranged from 3.9 to 15.1 per cent. In three of four orchards, all the fungicides (chlorothalonil, fludioxonil, thiophanate-methyl, myclobutanil) reduced the disease incidence. There were though significant differences in disease reduction among the fungicides. In all four orchards, propiconazole caused the maximum reduction in disease incidence. The experiment will be repeated in 2001.

Black leaf and witches' broom — *In vitro screening of fungicides*. Thirteen fungicides (azoxystrobin, benomyl, captan, chlorothalonil, Fenbuconazole, fludioxonol, iprodione, myclobutanil, propiconazole, sulphur, tebuconazole, thiophenate-methyl, and triademefon) at 1 ppm were tested for their ability to inhibit *in vitro* germination of spores of *Apiosporina collinsii*, the cause of Black leaf and witches' broom disease of saskatoon. Of these, chlorothalonil and azoxystrobin caused complete inhibition of spore germination, and thiophanate-methyl inhibited the germination to 11.1% of the control. These three fungicides were further evaluated at lower concentrations. Chlorothalonil completely inhibited the germination of spores at 0.1 ppm, whereas azoxystrobin caused the similar inhibition at 0.5 ppm. Myclobutanil, sulphur, and propiconazole which are registered for use on saskatoon were tested at higher than 1 ppm concentrations. Sulphur and propiconazole provided complete inhibition of spore germination at 50 and 100 ppm, respectively. Selected fungicides will be evaluated for their efficacy in controlling the disease in commercial saskatoon orchards.

Early blight disease of potatoes

This research project is funded by Potato Growers of Alberta and AARI. The cooperators on the project include Dr. J.D. Holley and Mr. J. Calpas, CDCS.

Fungicide tests for inhibition of growth of early blight pathogen (Alternaria solani) — Of 10 fungicides/fungicide combinations tested at 250 ppm, none was able to cause complete inhibition of *in vitro* radial growth of *A. solani*. Only azoxystrobin at 1000 ppm was able to cause a complete inhibition of the growth. Germination of spores, however was completely inhibited by chlorothalonil (Bravo) and fungicides containing chlothalonil [chlorothalonil + metalaxyl (Bravo/Ridomil), propamocarb +chlothalonil (Tattoo C)] at 1 ppm. Azoxystrobin was not effective in inhibiting the spore germination.

Comparative susceptibility of potato cultivars to Alternaria solani — Results of cultivar susceptibility of 1999 and 2000 taken together indicated that potato cultivars differ in their susceptibilities to *A. solani*. Both years Norland, Rode Earstling, Russet Norkotah were comparatively more susceptible than Rode Star, Russet Burbank, Chipeta, and Alpha. In general, the cultivars showed similar comparative reactions. Cultivar susceptibility experiment results from three sites in southern Alberta also showed Norland to be significantly more susceptible than Russet Burbank and Shepody.

Comparative virulences of Alberta isolates of Alternaria solani — There was a large variation in the virulences of isolates of *A. solani*. It was observed that per cent germination of spores of some isolates was lower than others, a repeat experiment is planned to minimize the effect of variation in per cent spore germination on comparative virulence. This experiment was conducted at CDCS.

Genetic characterization of Alberta isolates of Alternaria solani — Thirty-one isolates, based on their sensitivity reaction to chlorothalonil were selected for genetic characterization. Three isolates representing three sensitivity groups were selected to screen 80 RAPD primers on the basis of their suitability to produce genetic fingerprints that demonstrated differences among the isolates representing the three groups. Ten primers were selected to study the 31 isolates. The genetic fingerprinting work of all 31 isolates is near completion, the work remaining include statistical analysis and generation of a phenograph (family tree) showing the genetic grouping of the isolates resulting from the RAPD analysis. This experiment is being conducted at CDCS.

Fusarium dry rot of potatoes (*Fusarium* spp.)

This project is funded by Syngenta Crop Protection and AARI. Drs. L.M. Kawchuk, Agriculture & Agri-Food Canada, Lethbridge, and J.D. Holley, CDCS, are cooperators on this project.

In vitro screening of fungicides and their combinations for inhibition of mycelial growth of Fusarium sambucinum — Fludioxonil at 2 ppm and fludioxonil (Maxim) + mancozeb (Tuberseal) and fludioxonil + difenoconazole (Dividend) both at 10 ppm caused complete inhibition of mycelial growth of the pathogen. Except imazalil (Fungaflor) which caused similar inhibition at 50 ppm, none of the other fungicides were able to cause the complete inhibition even at 250 ppm, the highest concentration tested. Development of a product containing a combination of fungicides is a pro-active strategy to manage the development of resistance against fludioxonil.

Dry rot development in seed tubers — A field experiment was conducted to evaluate the efficacy of various pre-plant seed treatments in controlling the development of dry rot in seed tubers. Before pre-plant seed treatment, the seed tubers were inoculated with *F. sambucinum* and incubated for 5 days at 15°C and 50-60 R.H. Eight weeks after planting 10 mother tubers per replication were carefully dug out for dry rot observations. *Fusarium sambucinum*-inoculated seed tubers developed 100% infection with average tissue area rot of 41.7 per cent. Fludioxonil + difenoconazole + mancozeb, fludioxonil + difenoconazole, and fludioxonil + mancozeb completely inhibited the development of dry rot in seed tubers. Fludioxonil alone was also very effective in inhibiting the development of the disease in seed tubers. It reduced the incidence and severity of rot in seed tubers to 13.5 and 12.5 per cent, respectively. Thiophanate-methyl (Easout) was

unable to reduce the incidence of dry rot development. It did reduce the severity of the rot from 41.7 per cent in control to 20.0 per cent. Mancozeb reduced both incidence and severity of the rot but was significantly less effective than any of the treatment containing fludioxonil. Development of dry rot in mancozeb treatment was similar to that of uninoculated control. The results suggest that fludioxonil in combination with mancozeb and difenoconazole, and mancozeb or difenoconazole completely inhibited the development of dry rot in seed tubers. Fludioxonil alone reduced dry rot development but was not as effective as combinations. All treatments containing fludioxonil were significantly better than thiophanate-methyl and mancozeb treatments.

Effect of pre-plant fungicide treatment of Fusarium-infected seed tubers on inoculum potential of soil surrounding the progeny tubers — The effect of pre-plant fungicide treatment of potato seed pieces on spread of the pathogen from infected seed tubers as tested by evaluating the inoculum potential of the soil surrounding the progeny tubers by tuber disk technique. Soil surrounding the progeny tubers from fludioxonil, fludioxonil + mancozeb, and fludioxonil + difenoconazole treatments caused the lowest incidence of infection of potato tuber disks. Rate of infection of tuber disks indicates the potential of the soil to cause the disease in progeny tubers.

The results of this study showed that fludioxonil and fludioxonil combinations (fludioxonil + mancozeb, fludioxonil + difenoconazole, fludioxonil + difenoconazole + mancozeb) used as pre-plant treatment provide an effective control of dry rot development in seed tubers. Protection of potato seed pieces not only helps to produce high yielding quality crop but also reduces the amount of inoculum on progeny tubers going into the storage.

Late blight of potato

In last week of July, late blight infection was confirmed in a potato plant from northern Alberta. This was followed by many other confirmations of the disease in different fields. All infected fields, and many other potato fields were checked and individual growers were advised accordingly. The growers were very diligent and made every effort to check the spread of the disease and get rid of the disease inoculum.

Five *Phytophthora infestans* isolates from three fields were characterized for metalaxyl sensitivity, mating type, and genotype determination at CDCN and Agriculture and Agri-Food Canada, Research Centre, Lethbridge laboratories. All the isolates belonged to A1 mating type; two were of genotype US 11 and the other three belonged to a new genotype with one band at location 122; three isolates were sensitive, whereas the other two were moderately and highly resistance to metalaxyl.

Technology Transfer Services

Information on disease control was provided by presentations at industry meetings, farm visits, and by telephone. In addition, the research results were published in project research reports, industry and government newsletters, and scientific papers. The program leader attended many industry and scientific meetings and workshops including annual, area, breakfast, Potato Team and other industry meetings of the Potato Growers of Alberta; Western Potato Council; Alberta Horticultural Congress; Berry School of the Fruit Growers Society of Alberta; annual meeting of the Canadian Phytopathological Society; annual meeting of the Plant Pathology Society of Alberta; and Novartis Potato Seminar.

Potato Agronomy and Varietal Development Program

C. Schaupmeyer, C. Feth, M. Konschuh, L. Delanoy and M. Nielsen

The objectives of the potato program are to assist in the selection and development of improved potato cultivars and to establish methods for improving quality and maximizing economic yields in Alberta's potato industry. These objectives are accomplished through research and technology transfer.

In response to demands from Alberta's potato industry, Alberta Agriculture, Food and Rural Development (AAFRD) hired two additional professional staff in 2000. Dr. Michele Konschuh, research agronomist, started at the CDCS in June, 2000 and is working with program technologist Cathy Feth. In September, 2000, Lori Delanoy, extension agronomist, joined Clive Schaupmeyer at the AAFRD Taber office.

Research Projects

Potato cultivar improvement

CDCS is one of five cooperative tests sites in the Prairie Potato Breeding Program. The program is managed by Agriculture and Agri-Food Canada's potato breeder, Dr. Dermot Lynch, who makes crosses at the Lethbridge Research Centre (LRC) and does preliminary selections at the Vauxhall substation. Final testing is done at the regional sites. Performance of test lines in the regional trials is evaluated by the breeder, test site cooperators, and industry staff.

The primary objective of the breeding program is to select improved potato varieties adapted to the southern prairies. Varieties needed by the industry include a chipping variety that is more stable in long-term storage; an early chipping variety that will yield well and chip by the third week in July; an attractive fresh-market red potato that holds color in long-term storage; a maincrop fresh-market and French fry netted potato that is earlier than Russet Burbank and has better quality. As a cooperator in the Prairie Regional Potato Trials, five cultivar evaluation trials containing about 400 lines are planted and managed.

Prairie potato regional trials

More than 100 lines were grown in four Regional Trials at Brooks. Data were collected on 30 to 40 agronomic and quality factors including yield, maturity, specific gravity, culinary and processing quality. Data from these trials were sent to Dr. Dermot Lynch at LRC for analysis and summarization for the Prairie Potato Breeding and Selection Committee. Dr. Michele Konschuh can provide the results of variety trials at Brooks.

Alberta potato industry cultivar evaluation

Potato industry cultivar trials are continuing to evolve. The trials were originally established to evaluate (on a commercial scale) new potato cultivars that have graduated from the Prairie Potato Regional Trials. The trials enabled growers and processors to gain first-hand experience with new cultivars in the field and processing plant. Seven years ago the Prairie Potato Breeding Consortium was established and responsibilities for industry evaluation are evolving. The consortium is a corporation funded by membership fees paid by five groups (processors, grower-owned companies, and grower organizations) from the three prairie provinces. Fees are used to pay for research studies directly related to consortium varieties.

Breeding lines entering the registration trials in the Prairie Potato Breeding Program are available for tendering to consortium members. The first tendering process started in late 1995. Successful bidders were assigned either exclusive rights or non-exclusive rights and were authorized to control the production of seed. They are required to pay a

royalty to the consortium for the right of ownership. The owners of consortium varieties are responsible for market development of the varieties thus reducing the role of CDCS in this process.

Potato cultural research

Effects of in-row spacing on yield and quality of potato selections

Twelve cultivars and advanced lines from the regional trials were planted at three in-row spacings in four replicates in a randomized complete block design. The cultivars/lines planted were Atlantic, CV92057-2, V0024-6, V0123-25, ACLR Russet Burbank, Russet Burbank, CV92028-1, CV87101-1, FV9650-1, FV9249-88, FV9633-6 and FV11579-3. The in-row spacings were 22 cm, 28 cm and 40 cm. Yield, size distribution and quality data were measured.

Technology Transfer Services

The program extension agronomists, C. Schaupmeyer and L. Delanoy, provide extension service to growers and industry personnel through direct contact, newsletters and factsheets, and presentations at conferences and workshops. In 1993, the program agronomist started a series of extension meetings with growers in Southern Alberta. These were continued again in 2000 in cooperation with the Potato Growers of Alberta. Six meetings were held in Taber from April through November. Growers, industry staff, and research and extension staff attend these meetings and discuss production management. Attendance at each meeting during the past year was from 80 to 100 growers and industry staff in Taber. In total, approximately 600 growers and industry staff attended these informal extension/production meetings in 2000.

Staff continue to provide information and consulting services to growers, field staff, processors and allied trades as needed.

Seed Potato Program

P. Duplessis and T. Lewis

The main objective of the seed potato program at CDCN is to provide support to seed potato growers throughout Alberta. This is accomplished through research trials and extension services. The program works closely with the Alberta Seed Potato Growers Association to ensure that the needs of the industry are being met. In 2000, the seed potato program underwent a thorough program review with growers and Potato Growers Association (PGA) staff providing input. Changes within the program in the coming year will be based on this review.

Seed potato repository. The purpose of AAFRD's seed potato repository is to maintain a collection of disease-free cultivars and lines to ensure that all participants in the Alberta seed potato industry have equal access to plants for nuclear production. This is accomplished by multiplying disease-tested stock plants for private labs. In 2000, 22 public potato cultivars and accessions and nine private cultivars were distributed to private laboratories across the Western Provinces for multiplication. Plant Breeders' Rights issues are changing the face of high generation seed potato production in North America. Program staff continue to work closely with private breeders, their agents and Alberta Seed Potato Inc. to ensure that new varieties remain eligible for protected status while seed growers are increasing available seed stocks.

Potato spindle tuber viroid (PSTV) sampling. The year 2000 was the final year for potato spindle tuber viroid sampling in Alberta. The purpose of the program was to prove that the potato producing areas of Alberta are free of PSTV and make them eligible for European Union (EU) Zone status. Samples collected from seed farms across the province were submitted to the Centre of Expertise for Regulated Potato Diseases in Charlottetown, PEI. The project was funded through the cooperation of AAFRD, Alberta Seed Potato Growers Association, Canadian Food Inspection Agency and Agriculture and Agri-Food Canada. All samples submitted tested negative for PSTV. Once mapping is completed the hope is for all seed potato growers in Alberta to be eligible to ship potatoes to EU zones in Canada without the requirement of additional disease testing that is currently in place.

Research Projects

Insect monitoring

In 2000, the seed potato program attempted to coordinate a preliminary insect monitoring program throughout the province. All seed potato producers were sent yellow sticky traps to place in one field, change on a weekly basis and then return to CDCN. The purpose of this study was to gage grower interest and participation and to determine if aphids were present on the yellow sticky cards that were returned to CDCN. There were also nine yellow pan traps placed throughout the province in cooperation with AAFRD and industry staff. The pan traps proved to be a more successful trapping method. In 2001 the hope is to cooperate with growers and have more pan traps in the field. If funding permits additional staff will be hired to sort through the samples and identify potential problem pests. In the future perhaps PCR technology can be incorporated into an aphid identification program to determine if specimens are carrying viruses which are detrimental to the potato crop.

Greenhouse trial in cooperation with Nova Scotia Agricultural College (NSAC)

In 2000, preliminary work was carried out on the performance of tissue culture potato plantlets inoculated with *Pseudomonas* spp. strain PsJN. Work done at NSAC has indicated infected plants grow faster in an aseptic environment and produce more tubers when placed in the greenhouse. NSAC provided the inoculated and clean tissue culture plants of the varieties Atlantic, Red Pontiac, Norchip, Russet Burbank and Shepody. Alberta lines of the same varieties were provided as an additional control.

Study results are in the final stages, but initial observations indicate there was no benefit to using the inoculated plantlets. Final results should be available shortly. Tubers produced from inoculated plantlets will be placed in the field in 2001 to see if any differences are observed in that environment.

Red Norland trial

The Repository at CDCN contains several Norland lines and growers are continually asking which is the 'best'. In 1999, greenhouse tubers were produced of each Norland line as well as the new Idaho variety IdaRose. The nuclear tubers were planted in a replicated field trial in 2000. Harvest yield and size data were collected and tubers were ranked according to tuber type, color, splotching and overall appearance. Tubers will be re-evaluated throughout the storage season for color retention. The trial will be repeated in 2001 and the variety CalRed will be added to the trial. Early harvest may be included in the 2001 trial. Slides are available for interested growers to view and results will be presented following the completion of the 2001 field trial.

Variety demonstration trial

Potato varieties and selections maintained in our repository are grown in the greenhouse on an annual basis to ensure that the lines have remained pure and productive. Nuclear tubers produced at this facility are planted in the field for assessment of 'trueness to type'. Evaluation of potato cultivars is necessary to ensure that the Seed Potato Industry is provided with a high quality seed source. This past year,

and took the opportunity to look at the many cultivars in the repository. Visitors from Mexico were interested in the trial as were representatives from private companies looking at niche market varieties.

Prairie regional trials — early and main crop replicated trials

These trials are conducted annually in cooperation with the Lethbridge Research Station. They are an integral part of the AAFC Potato Breeding Program. New cultivars and accessions are compared with well-known standards to assess performance, maturity, yield, specific gravity, and culinary and processing quality. The observations are used to select new potato cultivars for the prairies.

CDCN was an early and main crop trial site in 2000 and was also an irrigated demonstration trial site for 11 advanced selections and eight industry standards. The early crop trial included four breeding lines and Atlantic, Carlton, Norland and Russet Norkotah as standards. The main crop trial included 20 breeding selections for evaluation. Norland, Russet Burbank, Russet Norkotah, Shepody, Atlantic and Snowden served as standards. Growers had the opportunity to tour the site on August 16 in conjunction with a PGA grower meeting and Dr. Dermot Lynch of AAFC was on hand to answer questions about the advanced selections.

Technology Transfer Services

Organized the following seminars/workshops:

- CDCN Potato Field Day and Grower Tour
- Summer meeting of the Alberta Potato Committee and the Seed Potato Program Review

Participated in meetings and conferences:

- Western Potato Council Annual Meeting, Lethbridge, AB
- Area meetings of the Potato Growers of Alberta
- PGA Annual Meeting, Red Deer, AB
- 19th Annual NPC Seed Seminar, Las Vegas, NV

The seed potato specialist provided extension services to growers and industry personnel through direct contact and presentations at meetings and conferences. She also acted as a liaison with the Canadian Food Inspection Agency to keep growers informed of regulatory changes.

The seed potato specialist and technologist worked closely with new and interested lab producers to help ensure that they had adequate training and resources.

Vegetable Crops Program (Brooks)

P. Ragan, W. Johnson

Applied field research and extension activities are designed to serve market gardeners, large-scale fresh vegetable growers, and contract processing growers. Variety adaptation and earliness enhancement of crops through improvements in cultural management practices are the main research activities of the vegetable program. Technology transfer is carried out through on-farm visits, publications and participation in commodity organization conferences and workshops.

Research Projects

Variety adaptation

Approximately 300 varieties of 10 types of vegetables were evaluated. In addition, succession plantings of transplant cauliflower and varieties were evaluated along with plant density treatments in carrot and cooking onion variety trials. Storage quality observations on all cabbage and onion varieties continued up to six months after harvesting.

Detailed results of varieties tested were reported in CDCS Pamphlet 2001-5 *Vegetable Variety Adaptation Trials 2000*. Copies were supplied to 30 participating seed companies. Workshops were held across the province in November to discuss findings and make recommendations to producers. These workshops also provided opportunities for producers to suggest priority areas for future research.

Production management trials

Detailed results of production management trials, along with summaries were reported in the CDCS Pamphlet 2001-4 *Vegetable Production Trials 2000*. A brief description of these trials follows.

Dehydrator Onion Plant Density

A processing white onion variety, Southport White Globe was planted to record bulb size and yield response to plant densities of 175,000 and 260,000 plants per acre. In a randomized complete block trial, overall yield remained unaffected by plant density, however, yield of medium grade bulbs increased at the lower plant density and yield of small grade bulbs increased at the higher plant density. Yield remained stable through a bulb sizing compensatory response to plant density.

Celery Gibberellin Timing

Eight varieties were treated to a 50 ppm concentration of GA_3 at a 30 and 40 day preharvest interval. In all varieties planted in a non-replicated trial, stalk length increased most at the 40 day preharvest treatment. Best responses were recorded in the varieties Improved Utah 52-70, Fuerte, Tango, Sabrosa and Florida 683. Stalk diameter also increased most at the 40 day preharvest treatment in these same varieties. Both these positive responses contributed to overall yield increase.

Carrot Plant Density

Thirty-eight varieties grown at plant density treatments of 390,000; 520,000; 990,000 and 1.2 million plants per acre in a non-replicated trial showed that carrot root size is highly influenced by plant density. As mean root diameter falls, plant density increases, this knowledge can be used to manipulate market requirements whether for fresh market or processing. Each variety responds differently to plant population treatments and therefore variety selection by producers becomes very critical in determining market requirements of a carrot crop.

Nitrogen and phosphorus rate influence on garlic production

This trial investigated the effects of spring band application of nitrogen and phosphorus on the yield and bulb size of garlic. A simple randomized complete block trial was used with the following treatments:

Variety: Music and Vernon, hard-necked continental types.

Fertilizer: nitrogen and phosphorus per acre interaction treatments of 100 x 200, 200 x 400, 300 x 200, 100 x 400.

This trial showed that garlic is not very responsive to nitrogen and phosphorous. Perhaps soil nutrient reserves were already adequate (N 23 and P 125). Yield and bulb quality were not influenced when both nitrogen and phosphorous were applied together in early spring, or in the fall (1999 trial).

Technology Transfer Services

A one-to-one, on-farm extension service was provided to producers in the southern region of the province. Specialized equipment was loaned to producers to encourage adoption of new technology. Popular items included: two precision drills, transplanters and plasticulture equipment. Program staff also provided a seed belt punching and calibration service for producers using Stanhay seeders. Seed lots are matched with the best combination of belt hole size and number of holes to ensure optimum plant density in the field.

Annual workshops for vegetable producers were given to provide variety recommendations and guidelines to data interpretation as reported in the CDCS Pamphlets 2001-4 and 2001-5. These workshops also provided an opportunity for growers to comment on the direction of research programs.

The *Processing Vegetable Growers Newsletter* was edited and posted quarterly.

Vegetable Crops Program (Edmonton)

B. Choban and C. McIsaac

The vegetable program at CDCN provides the vegetable growers in north and central Alberta with extension and applied field research that responds to growers' needs, current market demand and the industry's development and growth. The ultimate aim is to increase the skills and knowledge of vegetable producers so they can develop a self-reliant profitable industry.

Research Projects

Research focused on vegetable variety evaluations, vegetable crop diversification and vegetable crop production management techniques. Major emphasis was placed on crop maturity, product quality, crop yields and on crops that are economically viable to grow in Central Alberta. Seed companies from Canada and United States donated most of the seeds used in field trials. Funding to support a part-time summer labour position came from private commercial vegetable producers. A detailed research trial report is available on request by contacting CDCN for report CDCN #2000-V012, *2000 Vegetable Trials Research Report.* Trial research results were presented to industry through several grower workshops that were held in December at various locations throughout the province.

Asparagus variety trial

Nine varieties were planted in 1998-99 for production evaluation. The trial was maintained this year and data was not collected. Next year, production performance evaluation will be done on varieties that are ready for harvest.

Carrot varieties

Twenty-seven varieties and two harvests (early and late season) were evaluated for yield, quality, maturity and production suitability for central Alberta growing conditions. Evaluation was also done for taste (sweetness), color (dark orange) and root sizing (early sizing for early fresh markets and late sizing for storage ability). Aster Yellows was severe in all varieties. Excellent performing varieties in mid season were Idaho (a short carrot good for direct marketing), Bradford and Fontana (good carrots for early jumbo market). Late season excellent performing varieties were Kamaran, Napoli and Nelson.

Cabbage transplant variety trial

Thirty varieties were evaluated for early maturity, field holding quality (no splitting), head quality and late maturity for winter storage potential. The industry standard Parel was still the earliest maturing of excellent quality with up to one week of field keeping capability before splitting. It was closely followed by Balbro and then Faro which had excellent uniformity in maturing. The varieties Almanac and Atlantis matured early to mid season with excellent quality and good yields. Leaves were soft, pliable and suitable for making cabbage rolls. Cecil was still an excellent all-round variety for mid season harvest, having nice, round, solid, dense heads that were excellent for shredding. Sutri and Kaitlin were new varieties that performed well in mid season and matured slightly later than Cecil. Cha Cha, a new variety of Suey Choi and Kilosa, a Savoy type performed excellent in mid season.

Broccoli varieties and succession seeding

Eighteen varieties were direct seeded at three consecutive dates to coincide with early, mid and late season harvests and evaluated for field performance. The new varieties PX 260895 from Stokes and 1848 from Bejo performed very well in mid season harvests.

Cauliflower transplant varieties and succession seeding

Twenty-one varieties were transplanted at three successive planting dates to coincide with early, mid and late season harvests and evaluated for field performance. Due to cool, favourable growing conditions, most varieties performed well. Baldo was the earliest of excellent quality to mature, closely followed by Minuteman, Apex, and two new vanities from Vilmorin still un-named (NIZ-10-010F1 and NIZ-10-002F1).

Garlic varieties

Seventeen varieties were planted in fall (September 13) without straw mulch and again in spring (May 15). Once again the fall planting out-performed the spring planting. Under the cool, moist growing conditions that occurred during the season, the spring planted garlic produced excessive growth, thick stems and immature bulbs that did not cure and were susceptible to disease. From the spring planting, Music, Siberia and Vernon were the only vanities that produced marketable garlic with good yields. From the fall planting, most varieties performed well.

Spinach variety trial / raised seedbed verses flat seedbed

Four varieties were seeded into a raised seed bed and into a flat seed bed for performance comparison. The raised seed beds produced cleaner spinach that matured 2 weeks earlier and with high yields when compared to the flat seed bed production technique.

Sweet corn variety trial

Two gourmet types, one novelty red, one cobless type and two sugar enhanced types were evaluated for performance. Due to cooler than normal growing conditions, none of the varieties matured prior to frost.

Rhubarb variety trial

Seven varieties were field set in spring after being propagated and grown in pots during the 1999 growing season. Most varieties will be ready for selective harvests and performance evaluation next summer.

Technology Transfer Services

Transfer of technology and information was provided to growers and industry through direct contact, seminars, presentations at tours, field days, meetings, courses, conferences, extension publications and newsletter articles. Several vegetable growers workshops and seminars were presented, along with talks to rural farmers and agriculture service boards on diversification into vegetable crops. Soil fertility recommendations and specialized equipment demonstration services continued. Due to limited travel budget, on-farm consultation was limited and concentrated on emergency situations such as diagnostic problem solving. Alberta Market Gardeners Association (AMGA) provided financial assistance for the specialist to attend the B.C. Vegetable Growers' Short Course held in Abbotsford, B.C. Fruit Growers' Society of Alberta provided the financial support for attendance at the International Carrot Conference in Pasco, Washington, USA.

Liaison continued with Alberta Market Gardeners Association (AMGA), commercial seed companies, Alberta Horticultural Congress and other industry personnel. Liaison was maintained with the commercial/wholesale produce marketing industry for exchange of information on current market demands and consumer trends. Industry partnership continued with Northern Alberta Produce Marketing Association for Fall Harvest Festival activities to promote the production of fresh vegetables to the public. Partnership with AAFRD, Economics Sector for weekly contributions to the crop report bulletin continued.

Continued to be a resource person to AAFRD staff and related industry personal, including horticulture product team, rural business development staff, food processing and food safety staff, marketing staff, insurance adjustors, loan officers and credit advisors from financial institutes.

New Crop Development Unit

Dr. Stan Blade, Unit Leader

The mission of the New Crop Development Unit (NCDU) is to ensure that applied research, industry development and technology transfer activities are appropriately channelled to support the special crop industries in Alberta. This is consistent with the market-driven thrust of Alberta Agriculture, Food & Rural Development (AAFRD) programs and also fosters sustainable agricultural production. NCDU clients include primary producers, commodity organizations, agribusiness, food processing companies, Agriculture and Agri-Food Canada personnel, university scientists and other specialists, both within and out-of-province. The NCDU exists to promote and support crop diversification and value-added initiatives in Alberta.

The New Crop Development Unit is one of five work units within the Plant Industry Division (PID) of Alberta Agriculture, Food and Rural Development.

Special crops are defined as alternative or non-traditional crops that generally are grown on small acreages, often under contract, and usually outside the control of the Canadian Wheat Board. This definition is not bound by acreage, and it is recognized that crops designated as "special crops" will change over time. Some examples of special crops currently being grown on a commercial scale in Alberta include buckwheat, canary seed, caraway, chickpeas, coriander, corn, dill, dry bean, faba bean, field pea, chickpea, low-THC hemp, ginseng, lentil, medicinal plants, mustard, peppermint, safflower, spearmint, sugarbeet, sunflower, wild rice, and miscellaneous herbs and spices. NCDU programs encompass all of these crops, with emphasis on those of greatest economic importance.

Most special crops are produced under contract or for direct marketing, and much of Alberta's production is exported. There is considerable value-added processing of crops such as mustard, sugar beet and herbs and spices. Others, such as sunflower, lend themselves to consumer marketing. The value of processed special crops in Alberta has not been established.

The NCDU receives strategic direction directly from the crop and processing industries it serves, as well as from commodity organizations, e.g. the Alberta Pulse Growers Commission and the Alberta Special Crop, Horticulture and Forage Product Teams. All programs in the Unit are reviewed every three years by scientific colleagues and industry representatives, including producers, processors and agribusinesses.

The following programs currently comprise the NCDU: administration, plant pathology, post-harvest technology, soil and water agronomy, special crops, and weed science. All of these programs are represented at CDCS. In addition, there are NCDU staff at CDCN (special crops, farm team, administration and apiculture) in Edmonton, Fahler (apiculture) and the Beaverlodge Research Farm (special crops).

Apiculture Program

K. Tuckey and D. Colter

The apiculture section of Alberta Agriculture, Food and Rural Development provides extension and regulatory service to the beekeeping industry of Alberta. Offices are maintained in Edmonton and Falher.

Apiculture registrations 2000

The Alberta Bee Act requires people who own and possess honey bees or beekeeping equipment in Alberta to register, annually, the number of colonies they own and the municipalities in which their bees are located (Tables 1, 2 and 3). The large number of beekeepers shown in Regions 2 and 4 reflects, in part, the number of hobbyist beekeepers living in Calgary and Edmonton.

The relatively large number of colonies in Region 1 reflects the honey bee colonies needed to service the hybrid canola seed production industry in that area.

Table 1. Number of beekeepers and colonies.

Region*	1999		2000***	
	Beekeepers	Colonies	Beekeepers	Colonies
N R**	6	4213	6	4616
1	75	52832	79	54775
2	157	16327	160	16512
3	102	28154	105	30888
4	269	54309	276	58821
5	112	55802	112	50647
Total	721	211637	738	216259

* Region as established by Alberta Agriculture, Food and Rural Development
** NR means non-resident beekeepers who operate colonies in Alberta
*** as of December 31, 2000

Table 2. Number of beekeepers — by region and size of operation.

Colonies operated	Number of beekeepers per region* 2000***						
	NR**	1	2	3	4	5	Total
0	-	13	45	18	51	11	138
1-50	1	43	91	56	159	41	391
51-600	1	11	19	15	43	34	123
601+	4	12	5	16	23	26	86
Total	6	79	160	105	276	112	738

* Region as established by Alberta Agriculture, Food and Rural Development
** NR means non-resident beekeepers who operate colonies in Alberta
*** as of December 31, 2000

Table 3. Bee colonies operated — by region and size of operation.

Size of operation	Number of colonies per region* 2000**						
	NR**	1	2	3	4	5	Total
1-50	16	581	883	633	1295	421	3829
51-100	100	100	851	200	1209	633	3093
101-200	-	560	436	854	1685	1412	4947
201-600	-	2355	2642	3206	6859	7734	22792
601-1250	2900	1104	1200	7352	11592	15047	39195
1251-2000	1600	2800	3500	5793	4628	6400	24721
>2000	-	47275	7000	12850	31553	19000	117678
Total	4616	54775	16512	30888	58821	50647	216259

* Region as established by Alberta Agriculture, Food and Rural Development
** NR means non-resident beekeepers who operate colonies in Alberta
*** as of December 31, 2000

Alberta beekeepers placed those 216,000 colonies in 6,802 beeyards or apiaries. Most of these beeyards are on land owned by someone other than the beekeepers and in most cases the landowners receive a "rent" of about 30 pounds of honey for the inconvenience of having bees on their property.

Economics of beekeeping

During the course of 2000 the price of raw bulk honey rose from about $0.75/pound to somewhat over $0.80 with the occasional report of sales close to $0.90. Actions during the year in the United States will have an effect on the price of Canadian honey — probably positive. The American Honey Producers Association filed an Anti-Dumping Petition against Argentina and China. By year end the US International Trade Commission had determined that American beekeepers had been harmed by honey imported from these two countries. Deliberations are still ongoing and the results will be important to Canadian beekeepers.

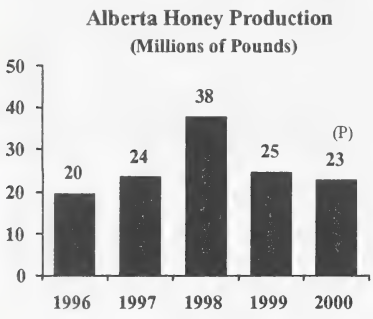
Sales of Alberta honey were being pressured by the movement of Argentine honey into the USA, as well as the European concern over genetically modified organisms (GMOs). Much of Alberta's honey comes from hybrid canola plants that are GMO and honey gets caught in the controversy even though all protein is routinely filtered from the honey.

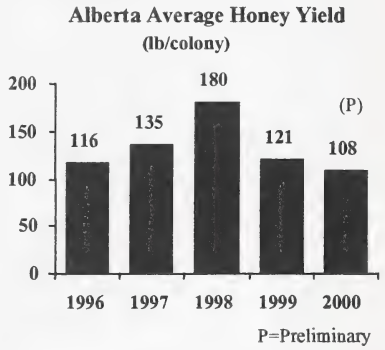
The demands of the hybrid canola seed production industry in southern Alberta continue to exercise a major influence on Alberta beekeeping. In 2000 at least 48,000 colonies were devoted to hybrid canola seed production. This is a reduction of 7,000 colonies from the 1999 high number. It is anticipated there will be a further reduction in honey bee colony use in 2001 but the long term projections are for a large increase in the number of colonies needed in this project. There are fluctuations as the fortunes of the canola industry vary from year to year. This demand for honey bee colonies is reflected in the tables above which shows a small number of beekeepers and a very large number of colonies in Region 1. As demand for honey bees increases, beekeepers from further afield were being attracted to this venture. It is known that these colonies will produce a very small honey crop—about 20per cent of the provincial average. The rental rate for these colonies stays competitive with the normal returns from honey production.

Alberta honey production 2000

Similar to 1999, there was only one area of the province with conditions that provided a good honey crop—around Edmonton. The colony survivability over the winter was down somewhat from 1998-1999. A mild winter led to a cold wet spring that retarded the development of honey bee colonies. Moisture levels seemed to have improved early in the year. However the south part of the province experienced dry weather that severely reduced the honey crop while much of the northern part had wet weather that prevented the bees from flying to forage for nectar. The good weather during the autumn allowed the bee colonies to be in good shape as they entered the winter.

As mentioned earlier the bees on canola pollination produce little honey. The honey production over much of the rest of the province was affected by the weather. It appears that the 2000 Alberta average honey crop will be about 108 pounds per colony for a total crop of 23,000,000 pounds.





Apiculture inspections and surveys

As varroa mites are found in more beekeeping operations, beekeepers are becoming more aware of the need to test their own bees for the presence of parasitic mites. The original Alberta varroa mite findings (1993 & 1994) were in operations that received honey bees directly from British Columbia. Since 1995 varroa mites have been established in the permanent bee population. The spread of varroa continues.

By the end of 2000 varroa mites had been reported in 160 beekeeping operations in 53 rural Alberta municipalities. Those 160 beekeepers operate approximately 162,000 colonies. However, not all bee colonies in each of those operations or municipalities, nor even most of them, are actually positive for varroa. Varroa mites have been identified through most of the province except for the St. Paul area and the east side of the province almost as far south as Medicine Hat.

Honey Bee Tracheal Mites are known to be in 200 operations located roughly in the same parts of the province as the varroa mites but now including some in the St. Paul area.

Most hive inspections carried out were at the request of owners—either to facilitate the sale of equipment or because the beekeeper perceived a problem. Colonies and/or equipment in 44 beekeeping operations were examined specifically for brood diseases.

Early in the year laboratory results showed that the American Foulbrood existing in one beekeeping operation was resistant to oxytetracycline hydrochloride (OTC). OTC is the only labelled preventative drug for the control of AFB. This new strain has been labelled rAFB. Some beekeepers submitted samples of AFB that they had found and AAFRD's Apiculture Section staff carried out some preliminary inspections to get an idea of how wide spread the problem might be. During the year 46 operations were inspected for AFB with 21 found to be AFB positive. Samples from these operations were submitted for lab analysis and 14 operations were deemed to have rAFB. These operations are widely distributed across the province and operate 22,000 colonies. This

testing was not extensive enough to provide a statistically valid picture of the extent of rAFB in the province but it does indicate that the industry has a significant problem.

There is no question that this rAFB is a serious threat to beekeeping in Canada. Alberta Agriculture, Food and Rural Development, Agriculture and Agrifood Canada and the Alberta Beekeepers' Association are working together closely on a number of fronts to combat this problem.

Interprovincial movement of honey bees

A permit is required from Alberta Agriculture, Food and Rural Development to move Canadian honey bees into Alberta. Regulations also require that all bees coming into Alberta from provinces known to have varroa mites must be treated for the control of the mite prior to entry. A number of shipments were checked to confirm compliance with this regulation.

During the spring of 2000 permits were issued for the importation of 11,000 colony units (packages, nucleus or full size colonies) into Alberta from British Columbia. Most of these units were Alberta bees that were taken to BC in the fall of 1999 to winter in southern BC.

Overwintering honey bees

Alberta beekeepers continue to winter their honey bees in British Columbia, in ventilation controlled buildings or outdoors. Bees are wintered in a number of formats. The most common way is as two brood chamber colonies outdoors but a few beekeepers utilize three super colonies to winter outside. Bees that are wintered indoors or in British Columbia may be one or two brood chamber colonies or nucleus colonies (nucs) with only five or six frames. Table 4 provides wintering statistics for recent years.

During the winter of 1999/2000 a few beekeepers suffered exceptionally heavy losses caused by parasitic mites that had not been controlled the previous year.

Table 4. Winter survival of honey bee colonies.

Year	Colonies operated *	Units into winter		% Survival
1995-1996	180000		174000	69
1996-1997	164000	In	64,000	82
		Out	102,000	80
1997-1998	174000	In	55,000	87
		Out	117,000	89
1998-1999	205000	In	64,000	83
		Out	133,000	83
1999-2000	211637	In	63,425	80
		Out	146,133	82
2000-2001	216,000#		214,000#	N/A

* indicates the number of colonies operated prior to the winter
# estimate

Government Programs

Agriculture Financial Services Corporation-Insurance Division

This joint Federal, Provincial and industry program continued to protect 37 Alberta beekeepers operating 46,000 colonies from losses due to poor honey yields compared to their long-term average yield. Twenty beekeepers made claims totalling $788,000 against the program. This program has experienced significant losses for several years in a row and is currently being reviewed as part of a larger review of the whole Crop Insurance program.

Net Income Stabilization Account (NISA)

This joint federal, provincial and industry program, which assists farmers to provide long-term monetary security for their farms, was first offered to beekeepers in the 1992 taxation year. Since then the program has been very popular with beekeepers and 211 beekeepers made contributions on $6,862,983 of net honey sales for the 1999 year.

Farming For The Future and On Farm Demonstration Program

These provincially funded programs assist in basic and applied research and in proving the worth of new ideas on the farm. From time to time beekeeper related subjects are tested.

Farm Income Assistance Program (FIAP)

The provincial government initiated this program in the spring of 2000 and repeated it in the fall. On the recommendation of the Apiculture Section and in recognition of the effects of drought, low prices and rising costs, beekeepers were included in the fall program for support at the rate of $3 per colony to all registered beekeepers with 20 or more colonies. This program should inject over $600,000 into the Alberta beekeeping industry.

Statistics

Each year the Production Economics and Statistics Branch of Alberta Agriculture, Food and Rural Development does a survey of beekeepers to determine the amount of crop received and other data about the Alberta beekeeping industry. This information is forwarded to Statistics Canada and included in country-wide figures. As well the same section periodically collects data on the economics of the industry. These are published as Agdex # 821-62. The latest compilation was for the 1999 crop. For the second time the study looked at beekeepers involved in the hybrid canola pollination.

Canada-Alberta Farm Business Management Initiative

A profile on the "Commercial Honey Industry" was published in AgVentures Series, Agdex # 616/830-1 during 1998. It is still available and serves as a valuable resource for persons wanting to get into or expand commercial beekeeping.

Technology Transfer Services

Both apiculturists provide monthly articles to the *Alberta Bee News*, published by the Alberta Beekeepers' Association. Talks were given to the annual meeting of the Alberta Beekeepers' Association and to local beekeepers meetings upon request.

A large part of any summer office time is used providing advice to members of the public who have called with "honey bee" problems. At least half the time the insects involved are bumble bees or some type of wasp and some time is used to provide suggestions for solutions.

Beekeepers and potential beekeepers consult the apiculturists on a regular basis requesting information or service. E-mail is becoming a very important communication device to beekeepers. Thirty three per cent of the beekeepers have provided e-mail addresses. E-mail is routinely used to provide timely information to large segments of the Alberta bee industry.

Interpreting the beekeeping industry to other segments of the government, and to industry, is an important facet of the duties of this section.

Plant Pathology Program

K.F. Chang, R.J. Howard, M.A. Briant, D.A. Burke and X-X. Zhao

The plant pathology program has a mandate to conduct applied research on important diseases of horticultural, forage and specialty crops. This research encompasses field, laboratory, growth chamber and greenhouse experiments, as well as disease surveys. Findings from this work and from the research of other scientists are presented to commercial producers through technology transfer programs. The plant pathology program also provides service in the form of support to crop production research programs at CDCS. Some plant pathology projects are also discussed in the report of the post-harvest technology program.

Research Projects

Diseases of pulse crops

Screening of bean cultivars for resistance to halo blight

Sixteen bean cultivars, comprising six market classes, were tested for their resistance to bacterial halo blight (*Pseudomonas syringae* pv. *phaseolicola*; *Psp*) under greenhouse conditions at CDCS, Brooks and under field conditions at Bow Island and Brooks. Disease reaction of these cultivars was similar at both sites. In a growth chamber study, cultivars that showed small (< 9.0 mm) foliar lesions after infection by *Psp* bacteria were AC Earlired (small red), UI 906 (black), AC Skipper (navy), CDC Crocus (great northern) and Alberta (pinto). Under field conditions, AC Earlired had a significantly better emergence rate than two other small reds, AC Red Bond and NW63, but there were no significant differences in disease incidence (DI) among these three cultivars. For black beans, Onyx had the highest emergence rate among tested cultivars, but CDC Expresso and UI 906 had the significantly lower DI than Onyx or GTS 093. For Great Northern beans, US 1140 had a significantly higher emergence rate than CDC Crocus. There were no significant differences in seed emergence or DI among pink, navy and pinto cultivars.

The effect of initial bean seed infection rates on bacterial blight progress

Bean seed was infected with *Psp* at nine rates (0, 3, 5, 10, 20, 40, 60, 80 and 100 per cent), planted in pots and grown in growth cabinets. The three highest infection rates resulted in significantly reduced emergence rates compared to the low infection rates (0 to 40 per cent). Infection rates did not cause a significant differences in disease incidence among the infected treatments because, once the disease was established, it spread very rapidly among the pots. Plants grown from seed with 0 per cent infection had a significantly lower disease severity than those from infected seed.

Evaluation of fungicidal seed treatments to control rhizoctonia root rot of dry bean

Seed of dry bean cvs. US 1140 and UI 906 was treated with Vitaflo 280 at 2.6 mL/kg, Captan 400 at 2.1 mL/kg seed, Vitaflo 280 + Apron FL at 2.6 and 0.05 mL/kg seed, and a combination of LS 176 and Apron FL at 3.1 and 0.16 mL/kg seed, respectively, and seeded into experimental field plots in a randomized complete block design with four replications. *Rhizoctonia solani* inoculum was incorporated with the seed at the time of seeding. All seed treatments in the trial improved plant stand and seed yield over the non-treated inoculated control. While all seed treatments in the trial resulted in a similar yield, the two Vitaflo 280 treatments and the LS 176 produced better plant stands than the Captan seed treatment.

Evaluation of fungicidal seed treatments to control rhizoctonia root rot of chickpea

Seed of chickpea cvs. Myles and Sanford was treated with Vitaflo 280 at 3.3 mL/kg seed, Crown at 3.0 and 6.0 mL/kg seed and a combination of LS 176 and Apron FL at 3.1 and 0.16 mL/kg seed, respectively using the previously mentioned experimental design and inoculum. Where Vitaflo and Apron were applied and where Crown was applied at the higher rate, emergence and seed yield were higher than the inoculated control, LS 176, Crown applied at the lower rate, and for Apron applied alone. Stands and yields were higher for Myles than Sanford.

Control of fusarium, rhizoctonia and pythium root rots of chickpea with fungicidal seed treatments

Three trials with the same seed treatments and experimental design were set up in the fields at CDCS, Brooks in the spring of 2000 to control each of the diseases. Seeds of chickpea cv. B-90 were treated with Apron Maxx at 3.75 g a.i./100 kg seed, a combination of Maxim and Apron XL at 2.5 and 3.75 g a.i./100 kg seed, a combination of Maxim, Apron and Dividend (MAD) at 2.5, 7.5 and 12 g a.i./100 kg seed, respectively, alone and combined with Cruiser at 50 g a.i./100 kg seed. Seeds were also treated with Vitaflo 280 at 88 g a.i./100 kg seed. Experimental plots were established in a randomized complete block design with four replications. Non-treated seeds were planted as inoculated and non-inoculated controls.

- Rhizoctonia root rot: Both MAD formulations and Vitaflo 280 improved seedling emergence and seed yield over the inoculated control, but Apron XL + Maxim and Apron Maxx didn't.
- Pythium root rot: All of the fungicides applied in the trial resulted in greater seedling emergence and seed yield compared to the inoculated or non-inoculated control. Apron and MAD formulations resulted in a greater seedling emergence than Vitaflo 280.
- Fusarium root rot: All treatments produced higher seedling emergence and seed yield than the inoculated control, and all treatments, except Vitaflo 280, had higher seedling emergence than the non-inoculated control. There were no significant differences in emergence or seed yield among the five chemical treatments.

Control of rhizoctonia collar rot of soybean with fungicidal seed treatments

Seed of soybean cvs. Gaillard and Mario was treated with Vitaflo 280 at 2.6 mL/kg, Captan 400 at 2.1 mL/kg seed, Vitaflo 280 + Apron FL at 2.6 and 0.05 mL/kg seed, respectively, and a combination of LS 176 and Apron FL at 3.1 and 0.16 mL/kg seed, respectively. Experimental plots were seeded in a split-plot randomized complete block design with four replications. *Rhizoctonia solani* was incorporated as inoculum at the time of seeding. All seed treatments in the trial improved seedling emergence and seed yield over the nontreated inoculated control. Vitaflo 280 showed the greatest improvement among the seed treatments, both in seedling emergence and seed yield. LS 176 and Captan 400 improved plant stand and seed yield to a lesser extent and LS 176 showed greater seedling establishment than the Captan 400 treatment.

Diseases of Herb Crops

Effect of essential oil and insecticidal sprays on the aster yellows in *Echinacea* spp.

Plots of *E. purpurea* (*Ep*) and *E. angustifolia* (*Ea*) were established in the summer of 1999 at CDCS. Weekly sprays to control the leafhopper vector of aster yellows (AY) using eight essential oils and three insecticide sprays were started in the first week of June, 2000 until the last week of September. Heavy AY infection (>93%) appeared in *Ep* in all plots treated with oil and insecticide treatments, but very low disease incidence occurred in the second-year *Ea* plants. All oil and insecticide sprays reduced the disease incidence. The incidence of AY was more than three times higher on control plants (5.3%) than on plants sprayed with oil of caraway (1.6%), garlic (1.1%) or monarda (1.6%). Insecticidal sprays also helped to reduce AY on *Ea* plants but not on *Ep*.

Another project to control AY using foliar sprays of Pyrethrin, Rotenone,

diatomaceous earth (DE) or garlic oil was initiated last year in cooperation with the Saskatchewan Herb and Spice Association and AAFC at Saskatoon. Disease incidence was recorded in July, 2000 in field plots set up at Aberdeen, Moose Jaw and Saskatoon in 1999. The efficacy of these treatments was determined by the incidence of AY on caraway, coriander, echinacea, feverfew, and valerian in 1999 and 2000. In 1999, Pyrethrin spray reduced the disease incidence more than the other treatments at Aberdeen. *Echinacea angustifolia* had the lowest disease incidence among the crops showing disease at all locations, especially in Saskatoon. However, there was no significant difference in AY incidence among the treatments at any location. The disease incidence was lower at Aberdeen than at Moose Jaw. In 2000, no AY was found on seedlings of feverfew at Saskatoon. For valerian, more than 50 per cent of the plants were killed either by low temperatures or by root rot diseases at Aberdeen and Moose Jaw. This situation made it difficult to determine AY incidence among treatments. For annual caraway and coriander, very low AY incidence appeared at all locations among treatments.

Effect of intercropping *Echinacea purpurea* with repellent plants on the incidence of AY and on populations of leafhoppers

In the second year of the trial, intercropping *Ep* with tansy significantly reduced AY incidence. Yarrow and mint also reduced AY incidence to a lesser degree, but there was no reduction in disease among the rest of the plants. However, the above-mentioned plants had a strongly intrusive effect toward *Ep* plants. The lowest monthly leafhopper counts were recorded in garlic and garlic chive, followed by sacred basil and scented geranium. Leafhopper populations seemed to correspond with increasing density and growth of the repellent plants. Populations also increased during periods of warm temperatures, such as the 4th week of August.

Testing microorganisms for control of seedling diseases of *Echinacea angustifolia* caused by *Rhizoctonia solani*, *Pythium* spp. and *Fusarium* spp.

In the laboratory, five fungal and seven bacterial isolates were tested against 4, 20 and 10 isolates of *R. solani*, *Pythium* spp. and *Fusarium* spp., respectively, on potato dextrose agar (PDA) plates. Antagonistic effects were demonstrated by clear inhibition zones between colonies of pathogens and the potential antagonists. The bacterial isolates used were *Pseudomonas fluorescens* (#AB254) and *Bacillus* spp. (#1, 2, 2a, 3, 3a and F6S2-7). Bacterial isolates 3 and 3A showed antagonistic effect to all pathogens tested. The largest inhibition zones were observed between bacterial isolates 3 and 3A and *Fusarium* isolates 63, 88 and 61. The smallest inhibition zones were observed between bacterial isolates #3 and #3A and *Fusarium* isolates 49 and 32. These two bacterial isolates also produced 0.7 to 1.0 cm inhibition zones within *Pythium* spp. colonies. Five fungi (*Penicillium bilaii* , C-Gr-001, Cy-Tr-003, G-Tr-004 and DL-G-Gr-1) were plated onto PDA plates with the *Fusarium* isolates 32, 49, 60, 61, 63, 72, 73, 78, 79 and 88. The fungal isolates C-Gr-001 and *P. bilaii* exerted antagonistic effects on certain *R. solani* isolates. *P. bilaii*, was the only fungal isolate that inhibited *Pythium* isolates and induced 2.6 to 4.8 mm inhibition zones within the colonies.

Mr. Xiao-Xiang Zhao, a visiting scientist from the Institute of Applied Microbiology, Harbin, China joined our program for six months to screen microorganisms for control of damping-off in echinacea. Fifty-eight isolates of bacteria were isolated from soil and from the rhizosphere of several crops at CDCS. Among them, 15 were very strongly antagonistic on *Pythium ultimum*. Another five of the bacterial isolates generated smaller inhibition zones when paired with *P. ultimum*. Thirteen isolates of Actinomycetes and other fungi were also isolated from soil samples and tested for their antagonistic effect toward the above mentioned pathogens and *Sclerotinia sclerotiorum* on PDA plates. Six isolates inhibited growth of *P. irregulare*, while only two isolates inhibited growth of the other pathogens in the trial.

Pot studies of damping-off of *E. angustifolia* caused by *Pythium* and *Fusarium* spp. were conducted in the greenhouse. Two biocontrol isolates showed promising activity in preliminary trials, which will be repeated in the future.

Pathogenicity study of *Fusarium* spp. onto *Echinacea* spp. and its concentration and temperature effect on the disease development

Three greenhouses were surveyed for root rot diseases in *Echinacea angustifolia* during May and June. *Fusarium* spp. and *Pythium* spp. were the most commonly isolated fungi from diseased seedlings. For the pre-emergence damping off trial, 14 *Fusarium* isolates showed strong virulence among the 68 isolates tested. A repetition of the trial proved that *Fusarium* isolate #63 was the most virulent of the isolates. For the post-emergence damping off trial, *E. angustifolia* was the most susceptible to infection among the tested three species of *Echinacea*.

Higher concentrations of *Fusarium* spp. inoculum tended to increase disease mortality in *E. angustifolia*. Effect of temperature [16/10, 22/12 and 28/18°C (day/night)] on the disease incidence in *E. angustifolia* was studied in growth chambers. The highest mortality (>80%) of seedlings occurred at 16/10°C while the lowest mortality occurred at 28/18°C.

The effect of temperature on the growth and on the aggressiveness of *Rhizoctonia solani* to *Echinacea* spp.

The growth rate of different isolates of *R. solani* was determined on PDA plates at 30, 25, 20 and 15°C. At 30°C, the fungus covered the whole surface of the plates in approximately two days, while it took an additional 1 to 3 days to occupy the same area at the other temperatures. There was a slight difference in growth rate among isolates in each temperature tested. Isolates of *Ea*-8, *Ea-Br*-6b, *Ea*36 and *Ea*-St-3 had the slowest growth rate at 30, 25, 20 and 15°C, respectively. All isolates of *R. solani* infected seedlings of *E. angustifolia* and *E. purpurea* at temperature regimes of 20/10°C, 25/15°C and 32/22°C and caused leaf yellowing symptoms. Further infection resulted in a blackish basal petiole and shrinking and drying leaves. Some isolates, such as St-7, 7a, 16, and 15, induced significantly higher mortality on *Ea* at 25/15°C than at 32/22°C. The reverse was true for the isolate of St-11. Generally, seedlings of *E. angustifolia* were more susceptible to *R. solani* than those of *E. purpurea* at 25/15°C and 32/22°C. The pathogen generally did not kill 3-month-old plants at 20/10°C.

The occurrence of powdery mildew of *Echinacea* spp. in Alberta

The disease was found for the first time in the province in an experimental field at CDCS. The plants were also infected with aster yellows. Whitish mycelium covered the whole surface of the plant and induced various sizes of lesions on stems. The disease most likely appeared in the middle of August when temperatures started to cool. Lesions on stems had reddish margins with white mycelium covering the central area. The average spore size was 35.7 x 17.1 μm and ranged from 24.8-49.1 μm x 9.0-22.5 μm. Infected plants were more prone to frost damage and died in late September. Based on the morphology of the conidia, the pathogen was identified as *Erysiphe cichoracearum*. This same disease was reported on echinacea in B.C. last year.

Varietal response of basil to *Sclerotinia sclerotiorum* under greenhouse conditions

Twenty-four basil cultivars were tested for their susceptibility to *S. sclerotiorum*. Seeds were sown in germination trays then transplanted into 4-cell root trainers filled with soilless mix. Naturally formed sclerotia and agar discs were used as inocula. The cultivar with the largest lesion was Ararat followed by Mammoth. The cultivar with the smallest lesions was Thai Siam Queen followed by Thai, Lemon and East Indian. The most susceptible cultivars were Ararat, Dark Opal and Genovese Nufar; the least susceptible were Thai Siam Queen, Thai and Lemon.

Etiology of mint stolon/rhizome rot

Nine fields of peppermint, scotch spearmint and Japanese mint were sampled at Carmangay, Bow Island and Arrowood throughout April, May and June, in 2000. Tissue samples from diseased stolons were incubated on acidified potato dextrose agar at 4°C and 20°C for 4-6 weeks. A total of 8560 isolates were identified visually as *Fusarium* spp., bacteria, *Alternaria* spp. or *Rhizopus* spp. These comprised more than 95 per cent

of the isolates. Approximately 169 isolates were tested for pathogenicity in four 4-cell root trainers. In the greenhouse trial, approximately 16, 22, 46 and 17 per cent of the seedlings were rated as healthy, moderately infected, severely stunted and severely wilted or dead, respectively. Of the 169 isolates tested, 38 were pathogenic and were rated as moderately severe in both greenhouse and growth chamber trials. These 38 fungal isolates included *Cylindrocarpon* spp., *Fusarium* spp., *Alternaria* spp., *Penicillium* spp., *Phoma* spp., *Pythium* sp., *Rhizoctonia solani* and *Sclerotinia* sp.

The occurrence of valerian sclerotinia blight and its chemical control

Sclerotinia blight was found on 1- and 2-year-old valerian plants in a commercial field near Morinville, Alberta in August, 1999. *Sclerotinia sclerotiorum* was isolated from diseased plants which showed dark brown to black lesions at the base of the petioles and on crown areas at soil level. The plants were inoculated with agar discs contain fungal mycelia and incubated in a mist chamber for four days, then drenched once with 20 mL of Benlate 50% WP, Botran 75% WP, Easout 70% WP, Ronilan 50% WP, Rovral 50% WP.,Tilt 250 EC or water (as a check). The trial consisted of three replications with 10 potted plants per replicate. The fungus infected the basal portion of leaf petioles and resulted in wilting. All of the fungicides tested controlled the disease.

Diseases of Floral Crops

Response of rose cultivars to rust under field conditions

Rose rust was prevalent in the rose garden at CDCS in 1999 and 2000. Despite repeated application of the fungicide Tilt in 1999, the fungus produced large numbers of telia on canes of 29 different cultivars in the spring of 2000, indicating that they were highly susceptible to the disease. The rest of the 50 cultivars surveyed were either moderately or highly resistant. Orange colored aeciospores appeared on the lower side of the leaves in the first week of June this year. Infected leaves may twist and grow upside down.

Diseases of Forage Crops

The occurrence of stem smut of intermediate wheatgrass

Stem smut (*Ustilago hypodytes* ([Schlecht.] Fr.) was found in a 70-acre field near Warner, AB in 1999 and caused 50 per cent yield loss in seed. The symptoms usually appeared in the first week of June. Brown sori developed on infected stems, especially between the uppermost node and the leaf below the flag leaf, and gradually became black during the period of seed filling. Teliospores were smooth, spherical to oval, light to dark brown, and 4.5 to 5.0 x 5.0 to 6.8 μm in dimension. Infected stems occasionally flowered, but did not set seed. This is the first report of stem smut causing significant losses to commercial grass seed production in Alberta, although the disease has been reported on crested wheatgrass and slender wheatgrass in other parts of Canada and in the USA. This disease could also have a significant impact on seed production of intermediate wheatgrass elsewhere.

Technology Transfer Services

Program staff spoke at five growers' and professional meetings in 2000. Thirteen scientific papers, eight abstracts and twenty four miscellaneous reports were published. Staff were involved in the activities of several professional societies and advisory committees.

Assistance was provided to Brooks Diagnostics Limited to diagnose several dozen plant disease specimens. BDL closed the doors of its diagnostic lab at CDCS in 2000. Program staff provided advice on disease identification and management to Centre staff and growers as requested.

R.J. Howard retained an Adjunct Professorship in the Department of Agricultural, Food and Nutritional Science at the University of Alberta. He and K.F. Chang served as committee members of the Prairie Registration Recommending Committee on Grain and the Western Committee on Plant Diseases.

Post-Harvest Technology Program

J.D. Holley

The primary objective of the post-harvest technology program at CDCS is to maximize the longevity and quality of stored horticultural crops. Research and extension efforts are both directed towards improving storage management practices used in industry today. Each year the program screens advanced breeding lines from the Western Canadian Potato Breeding Program (WCPBP) for levels of resistance to early blight, to verticillium and fusarium wilt, and to a range of storage diseases and physiological disorders.

The program worked on several short-term projects last year. Alfalfa cultivars were carefully observed to determine levels of field resistance to blossom blight infection. Thirty early blight isolates collected from farms all across Alberta were tested to see if new aggressive strains were responsible for unusually severe levels of the disease. The program also tested the efficacy of several new fungicides and a new disinfectant for controlling a range of diseases on potato.

One factor had a major impact on the post-harvest program in 2000. The computer-run post-harvest lab was upgraded to make it year-2000 compliant. Renovations were so extensive (costs exceeded $350,000.00), that delays in their completion drastically reduced the amount of available space for research last winter.

Research Projects

Field trials

Evaluation of cultivar resistance to alfalfa blossom blight

Seventeen alfalfa cultivars were planted in a four replicate, randomized, complete block trial at CDCS Macleod farm. Twenty mature flowers were taken from each plot replicate five times last summer and the pathogens colonizing them were isolated in the laboratory. Different levels of flower infection were found on different cultivars for both pathogens, i.e. *Botrytis cinerea* and *Sclerotinia sclerotiorum*. Results from last summer will be combined with results from the previous three summers to reliably document levels of cultivar resistance.

Early blight resistance screening

Small plots of four cultivars and twenty-three advanced breeding lines from the Western Canadian Potato Breeding Program (WCPBP) were established in a randomized complete block design with four replicates in soil that was heavily infested with spores of the early blight fungus, *Alternaria solani*. Levels of blight were recorded for all replicates in the third week of September. Three lines (AV82101-12, CV98101-1 and FV10996-12) had as much blight as the resistant standard, Russet Burbank. Two lines (CV889024-1 and FV9650-1) had as much blight as the susceptible standard, Warba. The remaining eighteen lines and two cultivars demonstrated intermediate levels of early blight resistance.

Stability of early blight resistance

Small plots of three cultivars (Norland, Shepody and Russet Burbank) were planted in four replicate randomized complete blocks at three locations to see if they would respond the same way to natural infection from different strains of the early blight pathogen, *A. solani*. Levels of early blight were recorded as described in the previous paragraph. Disease pressure was high at the first site, moderate at the second and low at the third. Levels of early blight were high on Norland and low on Russet Burbank at all sites. Levels on Shepody were moderate at the site where disease pressure was high but low at sites where levels of blight were lower. These results show that resistance to early blight infection is more stable for some cultivars, (Norland and Russet Burbank), than for others, (Shepody).

Early blight survey and aggressiveness testing

New aggressive strains of *A. solani* may be responsible for the sudden increase of early blight seen in many commercial potato fields over the past several summers. To test this hypothesis, leaves with early blight lesions were collected from eighty-six farms from across Alberta. Pure isolates of *A. solani* were recovered from every field surveyed. Thirty isolates were transferred to V-8 juice agar amended with rose bengal, exposed to high intensity light and spores used to inoculate leaves of greenhouse grown blight-susceptible potatoes (cv. Warba). Different isolates produced lesions that varied significantly in diameter three days after inoculation. Results showed that some isolates are able to colonize healthy leaves much more rapidly than others. Inoculation tests are being repeated again this winter to verify these results.

Isolates with different levels of aggressiveness were purified further using a standard single spore technique. DNA was extracted from single-spore purified isolates and PCR markers used to document genetic differences. Genetic differences will be compared to differences in aggressiveness to see if there is a significant correlation between the two factors.

Testing Quadris for efficacy against alternaria early blight

A large scale plot of disease-susceptible potatoes, cv. Shepody, was planted in small plot replicates at CDCS to test the efficacy of the new fungicide Quadris against alternaria early blight in typical field conditions. Fungicides were applied at seven to fourteen days intervals all summer. Unfortunately levels of blight were so low that it was impossible to evaluate the efficacy of this new fungicide. This field trial needs to be repeated.

Verticillium wilt resistance screening

Virulent cultures of two potato wilt pathogens, *Verticillium albo-atrum* and *V. dahliae,* were grown on sterilized barley seed three weeks prior to being used to inoculate seed at planting. Two cultivars and twelve advanced breeding lines were planted along with infested grain in an eight replicate randomized complete block field trial. Fifty tubers from each replicate were cut and examined for evidence of vascular browning from wilt infection after harvest. Percentages of tubers with symptoms were recorded and means calculated for each line. Three lines (V0056-1, V0266-8 and V0468-1) were more resistant and four (FV9633-6, FV9650-1, V0168-3, and V0416-7) as resistant as the standard, Russet Burbank. One line (V0379-2) was as susceptible and one (AV82101-12) more susceptible than the standard, Warba. The other lines had intermediate levels of wilt resistance.

Fusarium wilt resistance screening

A virulent culture of *Fusarium oxysporum* was established and used to plant and inoculate two cultivars and twelve advanced breeding lines in a second wilt screening trial using the method described in the previous paragraph. Two lines (V0266-8 and V0468-6) were as resistant as the standard, Russet Burbank. Two lines (WIS75-30 and V0379-2) were as susceptible and one (AV82101-12) more susceptible than the standard, Warba. The remaining lines had intermediate levels of resistance.

Storage trials

The consortium storage trial for processing quality and disease resistance

Twenty breeding lines from the Prairie Potato Breeding Program were harvested and transported to Brooks for post-harvest tests. Half of these potatoes were loaded into CES rooms with stable storage conditions at 6°, 8° or 10°C. Samples were taken from each of the three stable CES rooms to determine effects of temperature on chip, French fry, baking and boiling color and texture. Potatoes in the 8° and 10°C CES rooms retained good processing quality, however, quality of potatoes from most of the test lines was fair to poor at 6°C.

The other half were put into a CES room at 8°C with fluctuating levels of temperature and humidity. Tubers in the unstable 8°C CES room were subjected to stressful conditions to see how resistant they were to diseases that become more severe in storage after harvest, e.g. late blight, leak, silver scurf and pink, dry and soft rot decay. Tubers were also examined for evidence of susceptibility to bruising, cutting, discoloration or any other physiological disorder. Different cultivars/breeding lines had different levels of diseases and disorders.

Effect of foliar applied fungicides in reducing decay from late blight, leak and pink rot

Small replicated plots of potatoes were planted in four randomized complete blocks at sites in five provinces, i.e. British Columbia, Manitoba, Quebec, New Brunswick, and Prince Edward Island last spring. Plot replicates were sprayed with Gavel 75DF, Dithane DG, Dithane DG + Gavel 75DF, Dithane DG + Bravo/Ridomil Gold, Dithane DG + Curzate, Dithane DG + Quadris or with water every 7 to 14 days during the growing season. Potatoes were harvested from each plot replicate and shipped to CDCS for post-harvest testing. Potatoes were stored for six months in stable conditions at 6°C and 95 per cent relative humidity. Sixty healthy tubers were then removed from bags from each small plot and inoculated with three pathogens, i.e. one-third (twenty tubers) with *Pythium ultimum*, the leak pathogen; one-third with *Phytophthora erythroseptica*, the pink rot pathogen and one-third with *Phytophthora infestans*, the late blight pathogen. The proportion of surface area and volume of each tuber colonized by each pathogen was recorded at the end of a fourteen day incubation period. This series of experiments is incomplete so there are no results to report at this time.

Evaluation of three new pre-plant applied fungicides for potato

A large scale plot of disease-susceptible potatoes (Shepody), was planted in four randomized complete blocks to compare the efficacy of three new fungicides (Gaucho, Quadris and Tops MZ Gaucho) to one standard (Tuberseal) for the control of a wide range of soil/seed borne diseases (erwinia soft rot, fusarium dry rot, helminthosporium silver scurf, phytophthora pink rot, pythium leak and rhizoctonia black scurf). Quadris was applied as a spray to open furrows prior to planting at four rates, i.e. 0, 1.0, 1.75 and 2.5 g ai / 100 m. Seed pieces were coated with commercially prepared seed dressings of Gaucho, Tops MZ Gaucho and Tuberseal then planted in untreated furrows. Potatoes were harvested from two-fifteen meter rows from the centre of each small plot and weighed at harvest. Levels of each disease listed above will be recorded later this spring to determine whether application of fungicides at planting reduced disease levels on the daughter tubers. Data from this trial will be included in new use registration packages submitted to the Pest Management Regulatory Agency (PMRA).

Effectiveness of disinfectants as substitutes for fungicides on stored potatoes

Last year the disinfectant, Purogene, was granted an emergency registration for use on commercial potatoes to control storage diseases as a substitute for failing fungicides even though no efficacy data was required. Unfortunately research scientists do not know if disinfectants work as effectively as fungicides since disinfectants have no residual activity. Also there is growing concern that disinfectants, which are all strong oxidants, may corrode expensive storage equipment, e.g. metal air ducts, temperature and relative humidity sensors. Clearly there was a need to look carefully look at the use of disinfectants as substitutes for fungicides with well designed, carefully controlled post-harvest experiments.

Last September potato growers donated lots, each weighing two and one half tons of three cultivars (seven and one half tons in total) for the post-harvest testing of Purogene. The first cultivar (Norland) has been shown to be susceptible, the second (Snowdon) moderately resistant and last (Russet Burbank) resistant to a wide range of storage diseases. Lots of each cultivar were initially subdivided into four equal parts to prepare them for four harvest spray treatments. Potatoes from the first lot were thoroughly

washed then sprayed with the label rate of Purogene, a second lot sprayed with the same concentration of Purogene without being washed first, a third lot washed then put into long-term storage without being treated, and finally a fourth lot put straight into storage without being washed or sprayed first.

Each of the twelve large sample lots were subdivided into equal parts for three post-harvest mist treatments. Potatoes were stored in large wire screen pallet bins that had been sub-divided into four equal sections using notched wooden slats. Each quarter section of each pallet bin was used to store one cultivar/harvest spray treatment.

Individual pallet bins were assigned specific post-harvest mist treatments. Bins assigned to the first post-harvest treatment were exposed once a week to one-quarter of the maximum allowable monthly dosage of Purogene, bins assigned to the second treatment to the same dose half as often as the first, and bins from the last treatment were stored without being treated. Metal strips (aluminum, brass, copper, brass, galvanized steel, iron and stainless steel) were carefully cleaned weighed, attached to bins and examined regularly for any signs of corrosion.

A portable Gellert humidifier was used to apply Purogene mist in a tightly sealed fumigation tent inside a large CES room set at 8.0°C. Levels of temperature and relative humidity inside the tent were monitored with a Lakewood data logger. The Gellert humidifier was adjusted manually to keep levels of humidity at 90 per cent as the mist treatments were being applied. A second data logger was installed in the long-term CES room to compare conditions in the fumigation tent to those inside the long-term CES room. The calibration of both data loggers was checked regularly to determine whether oxidation from the application of Purogene mist generated excessive sensor drift.

The efficacy of each treatment was determined by comparing levels of diseases found on tubers just after they were treated at harvest to levels found at regular intervals (every six to eight weeks) over the winter in a disease-favourable CES room, i.e. one with unstable levels of temperature and humidity. Four replicates, each with twenty tubers, were taken from each small storage compartment for analysis. Tubers were washed, dried, then examined for symptoms of black scurf, bruising, dry-rot, late blight, silver scurf and soft-rot. Levels of each disease were recorded for each tuber at each sample time. Final results are not available for this trial at this time.

Technology Transfer Services

Routine telephone queries about potato and vegetable diseases and about storing potatoes, carrots and other garden vegetables were dealt with as they arose. The program leader, J. Holley, also published two articles in Agri-News. Publication of the Agri-News articles and a new AAFRD website identifying specialists doubled the number of telephone inquiries about how to best manage vegetables in storage over the winter. A chapter illustrating and describing alfalfa diseases was prepared for a new production guide.

Holley worked with Dr. Deena Errampali, (a research scientist with Agriculture & Agri-Food Canada in Charlottetown, PEI) on a helminthosporium silver scurf review paper last spring. The review paper was just recently accepted for publication by the British journal, Plant Pathology. Data generated by the post-harvest program was also used in three new publications describing three new cultivars releases from the WCPBP. These papers are still in press.

Holley assumed the responsibilities of chairman for the potato chapter for the Western Committee on Plant Diseases (WCPD) this year. Holley spent a great deal of time last fall updating the WCPD potato chapter. He also added a new section to it, i.e. a detailed description of pink rot disease, a serious storage disease caused by the fungus, *Phytophthora erythroseptica*. He gave two presentations on storage management and early blight at the annual meeting of the Saskatchewan Seed Producers Association in Saskatoon last fall. He continues to participate on the Alberta Potato Research Committee (APRC) and on the Storage Committee of the Prairie Potato Council (PPC).

Soil and Water Agronomy Program

R.C. McKenzie, S.A. Woods and L. Hingley

The soil and water agronomy program conducts research on water, fertilizer and sustainable soil quality requirements of special crops, horticultural crops and irrigated forages. Some research projects were done cooperatively with staff from other programs at CDCS and other divisions of Alberta Agriculture, Food and Rural Development (AAFRD). Soil samples were analysed by AAFRD's Soil and Crop Diagnostic Centre, Edmonton. Research funding was provided by the Potato Growers of Alberta, Westco, Southern Agri Services, Pan Canadian Petroleum and McCains. Farmers who cooperated with field research projects were J. Rozendaal of Hays, C. Perry of Coaldale, K. Sikkens of Barnwell and J. Miyanaga of Taber.

Research Projects

Precision farming

Site-specific management of potatoes

Site specific management involves applying adjusted amounts of inputs such as water, fertilizers and herbicides, as required, to different portions of a field. This is now feasible using Global Position System (GPS) controlled equipment such as fertilizer applicators or herbicide sprayers. At a less technical level it can be done by subdividing the field into different units and applying different inputs to each subdivided unit.

This project began in 1996 and will conclude in 2001. The objectives are:

- to measure and map yield variability within a field
- to determine the effects of soil type, landscape position, soil fertility, diseases and weeds on potato yield
- to determine the variability in yield of preceding crops, and to relate this to field variability and tuber production
- to measure the cost benefits and environmental influences of site-specific management
- to evaluate the use of remote sensing and digital image analysis of fields to detect nutrient deficiencies and diseases of potatoes

Two, 27 ha potato fields were monitored in detail. One was irrigated with a centre pivot and the other with a corner pivot. Soil texture was determined at 50 sample points, and at these points rainfall, irrigation and soil moisture records were taken. Plant petiole samples were taken three times during the growing season for nutrient analysis. Yield data and remote sensing imagery were also collected and compared to soil and crop characteristics to explain what caused variations in yield.

The data showed soil texture, tissue nutrient content and the available soil moisture status of potato fields were quite variable. Tissue phosphorus and nitrogen declined rapidly during the growing season in portions of the potato fields. The potatoes were deficient in tissue potassium in early July, in the first three years (1996-1998) but not in the fourth year (1999) on both fields, but there was adequate potassium on both fields at the end of July and in August. Low soil temperature is known to reduce the uptake of potassium, however, June and early July of 1999 had below normal temperatures and 1998 was above normal.

In 1996, soil moisture was lower under the outer portions of the center pivot and on the corners of the corner pivot system. In 1997, the centre pivot system was converted to a low pressure system and, as a result, water application was higher on the outer part of the system and lower near the centre. Tuber size and specific gravity was related to water application with fewer and larger tubers in the areas which received insufficient water as compared to areas with adequate water. This was the most important factor controlling yield and quality of tubers.

Yield was determined on strips which received various rates of nitrogen and phosphorus fertilizer and were compared to yields obtained from the farmer's fertilizer rates. In the fall of 1998, two rates of each of compost, manure and phosphorus were applied to one field. Manure and compost, as compared to phosphorus fertilizer, were found to significantly reduce the number of diseased plants and had no effect on the amount of rhizoctonia and scab on tubers. This is a positive result towards use of manure and compost as it indicates they do not increase diseases in potatoes and in some cases, may reduce the occurrence of disease.

Soil Fertility

Phosphorus Requirement of Potatoes

Southern Alberta has an expanding irrigated potato industry which is expected to reach about 18,200 ha (45,000 acres) by 2001. This will require rotations involving about 73,000 ha (180,000 acres).

The ability of potatoes to use phosphorus (P) is lower than many other crops which means they require more phosphorus fertilizer than most other crops. The P recommendations for potatoes in Alberta have been based on maximum applications of 40 kg/ha P (80 lbs/ac of P_2O_5). New recommendations developed in NW USA suggest maximum rates of 200 kg/ha P (P_2O_5 at 400 lbs/ac) on low lime soils and 256 kg/ha P (525 lbs/ac P_2O_5) on high lime soils. Alberta farmers are uncertain what rates to use.

Manure and compost are high in P content. Disposal of manure and manure compost often take place near the sources of the manure. This creates situations where the soils accumulate excess P and contribute P to surface waters. Most of Alberta's lakes and rivers within agricultural areas already contain excess levels of P and nitrogen. Alberta potato farmers are reluctant to use manure as a fertilizer because they believe it may cause scab on potatoes and contribute weed seeds. They are unfamiliar with compost, which has only become available in larger quantities since 1999. If manure and compost are proven to be a satisfactory source of P for potatoes, this will also aid in alleviating an environmental problem.

In 2000, three P experiments were set out. The field scale experiments had five rates of P from 0 kg/ha to 200 kg/ha and three rates of compost from 9 tonnes/ha to 36 tonnes/ha. Tissue nutrient levels, yields, tuber size, specific gravity and hollow heart were determined on both experiments. Increasing rates of P above 25 kg/ha had no significant effect on yield. In the first experiment tuber size was slightly reduced on treatments receiving high rates of P.

Applications of Drilling Muds to Agricultural Lands

Several types of drilling mud at three rates were applied to irrigated and dryland crops and to grassland to determine the effect of the muds on crop growth and soil quality.

Site Specific Application of Fertilizer N for Reducing Greenhouse Gas Emissions

This project was commenced in 2000 in collaboration with G. Kachanoski, University of Saskatchewan; I. O'Halloran, University of Guelph; R. Simard, Agriculture Canada, Ste Foy, Quebec, and D. Rolston, University of California Davis.
Current estimates of nitrous oxide (N_2O) emissions account for over 50 per cent of greenhouse gas emissions from agriculture. However, factors controlling N_2O emissions from soil are poorly understood. It is known that crop requirements for nitrogen vary significantly within fields. However, a majority of fields have a constant rate of fertilizer applied to them. Methods have been developed using GPS (ie. site specific or precision applications) to apply variable rates of fertilizer throughout the field. This project will measure the influence of site specific applications on reducing N_2O emissions.

Technology Transfer Services

Soil and water information was provided to a diverse audience through scientific papers, technical reports and research publications. Presentations were made at technical conferences and producer meetings and inquiries were answered through telephone contacts, office visits and correspondence. Frequent inquiries were received about the suitability of water quality for use in irrigation.

Information on crop tolerances to salinity and methods of measurement were provided to various groups. Research results on the use of phosphorus and compost on potatoes was presented to potato growers and soil specialists.

Special Crops Program (Edmonton)

S.F. Blade, N. Clark and L. Maskewich

Alberta producers are interested in diversifying their production. This was true in 2000 as prices for several conventional crops continued to tumble. One successful strategy is to incorporate new crops into the farming system. The special crops program is dedicated to introducing new crops that will contribute to the long-term viability of agriculture in the province. Diversification can contribute to improving crop rotations through inclusion of pulse crops, reduce the impact of price volatility on producers dealing in traditional crops, and expand opportunities for value-added processing in Alberta. Both large-scale conventional farmers and less-experienced entrepreneurs who wish to become involved in intensive production and processing opportunities presented for specific new crops are served.

2000 was a productive year for the special crops program at CDCN. Agronomic research capabilities were expanded with:

- The purchase of a Fabro no-till precision drill, to keep up with the current agricultural trend of direct seeding;
- The modification of Wintersteiger combine with new screens that widen harvesting capabilities;
- The utilization of the knowledge of Ken Lopetinsky, Provincial Pulse Agronomist, to expand the extension services of CDCN;
- The addition of Rachid El Hafid, Ph.D., who will work out of the Beaverlodge Research Farm and provide a northern perspective to the new crops research collected out of CDCS and CDCN; and
- Representation on the Provincial Pulse and Special Crops Team, AAFRD Special Crops Product Team, the Information Technology Committee, the Applied Research Strategy Group, and the Alberta New Crops Network.

Research Projects

The special crops program at CDCN has been active in the identification and development of promising economic crops since 1995. The focus has been research on several categories of new crops: pulse, spice, alternate, herb (medicinal, culinary and aromatic) and fibre crops.

Pulse Crops

Western field pea cooperative trial

In 2000, the special crops program entered three yellow and one green cotyledon breeding lines into the Western Field Pea Cooperative Trial. The lines performed very well; it is anticipated that after the second (and final) year of mandated testing that at least one of the lines will be registered and released for western Canadian growers.

Field pea breeding and germplasm evaluation

CDC Advance—To jumpstart the field pea breeding program CDCN staff were able to collaborate with the Crop Development Centre in Saskatoon to obtain early-generation lines from crosses which were targeted to the cool, moist conditions of Alberta. Following original unreplicated screening in 1996, a replicated preliminary yield trial in Edmonton and Grande Prairie in 1997 was completed. The elite material was put into an ongoing yield test in several locations in Saskatchewan and Alberta.

In 2000, a formal agreement was signed between the Alberta Pulse Growers Commission and the University of Saskatchewan pulse breeding programs to ensure that superior genetic material will be available to farmers in each province. These commissions have guaranteed long-term funding for the CDCN breeding program; and discussions are underway to include lentils and chickpeas into the agreement.

AAFRD/AAFC Breeding Agreement—In 1997 an agreement was signed between CDCN and the Agriculture and Agri-Food Canada Field Pea Breeding Program based in Morden, Manitoba. Approximately 200 lines were tested in 2000; the best lines will be determined and evaluated and by multilocation testing in 2001.

CDCN—1999 pea lines crossed in the greenhouse were planted in the field for the 2000-growing season. This new material will be evaluated with several objectives in mind: plant maturity, height, harvestability, plant architecture, disease resistance, seed vigor, and yield.

CDCN also collaborated with the University of Saskatchewan's pulse breeding program to increase seed yield of pea, bean, lentil and chick pea lines; and out-planted numerous selections from the World Germplasm Bank to examine pea lines that have economic potential as a sound agriculture crop for our region.

Intensive pea management (IPM)

The IPM Trial was originally set up in 1998 to evaluate the impact of four major management issues in the production of field pea across Alberta. Preliminary results indicate that rate of seeding and date of fungicide application were the two important variables affecting this study, which led to a shift in focus for the 2000 season, allowing us to concentrate on issues that have a direct affect on the growers.

Field pea inoculant trials

The first year of this experiment in collaboration with the Agriculture Canada Research Stations in Lacombe and Beaverlodge was conducted in 2000. The basis of the experiment was to determine the effects of inoculant formulations on nodulation (the symbiotic relationship between *Rhizobia* spp. and legumes).

New Millennium Silage Trial

2000 was also the first year for the new millennium silage trial. This experiment was conducted at four locations across Alberta (Vermillion, Barrhead, Grande Prairie, and Edmonton). The purpose of this trial was to look at protein content of grain and field pea intercropping at flat pod stage. The treatments incorporated varying levels of a cereal (barley or triticale) and Swing or Performance 4010 field pea.

Pulse crop screening (lentil, faba bean, chickpea)

In collaboration with several seed companies and breeding programs lentils lines were tested in Vermilion (in cooperation with Terry Buss), chickpea lines and faba bean (at CDCN). In collaboration with Randy Bjorklund the silage potential of ten faba bean lines was assessed by collecting data on biomass production and feed analysis. In collaboration with CDCS personnel four excellent fenugreek lines that have good nutritional composition and maintain forage quality until late in the season were evaluated.

Alternate Crops

Special crops adaptation trials

A screening/demonstration trial was planted at CDCN. This trial was used to assess the potential of crops like millet, grass, and specialty pea varieties for the central region of Alberta.

Herb Crops

Herb screening (medicinal, culinary, aromatic)

Approximately 200 species of annual, perennials, and tender perennials were started in the greenhouse, and transplanted and direct seeded in the field. This provided the research team with a preliminary screening process for a wide array of herbs that could have commercial potential in Alberta. The perennial herbs were left undisturbed to identify species that can overwinter.

Mint latitude trial

Mint is an economically important crop with potential for commercial production in Alberta. The second year of the mint latitude trial to was conducted this year to determine plausible growing regions, and if latitude affects essential oil content of spearmint and peppermint. Trials were planted in Edmonton, Brooks, Lethbridge, St. Paul, and Grande Prairie and monitored for disease and winterkill. The mint was harvested in the fall and sent to CDCS for distillation.

Fibre Crops

Low THC hemp research

In 2000 low THC hemp research at three locations in collaboration with two private growers continued. Silage, rate of seeding and varietal trials were conducted at CDCN, in Kirriemuir, and in Hamruka, Alberta. Preliminary results indicate rainfall is essential for a profitable harvest.

Technology Transfer Services

Due to the high interest in special crops, staff was called upon to answer numerous enquiries regarding a range of new crop opportunities relating to pulse, spice, medicinal and fibre crops. Staff contributed articles on crop diversification and species-specific topics to producer newsletters, industry periodicals and provincial newspapers. The interest in crop diversification resulted in several media interviews that were the source for further enquiries from the general public.

The demand for increased knowledge regarding new crops resulted in courses, seminars and field tours. The Special Crops Field Day held at CDCN was a tremendous success; and our total number of tour participants throughout the year totaled more than 500 individuals. CDCN staff also assisted members of the Pulse and Special Crops Team with obtaining planting materials for demonstrations across the province, and distributing technical information to clients.

A new innovation was involvement in Ask The Expert and Agri-Ville electronic forums provided an opportunity for staff to interact directly with producers in a new and highly effective forum. Clients included producers, other AAFRD Units, universities, Agriculture and Agri-Food Canada, other provincial agriculture departments, applied research associations and agri-industry. Many of the trials were done as researcher-managed on-farm experiments, which allowed neighbors to view technological innovations in their own area. Program staff served as college and university guest lecturers, independent study course mentors (U of A) and resource people for a number of industry organizations.

The special crops program would like to acknowledge the contribution of Jackie Tieullie, Jo-Ann Berry, Sandy Smith, Tracey Dryden, Linzi Martin, Jennifer Walychow and Nadia Geschke for their assistance in 2000.

Special Crops Program (Barrhead)

K.J. Lopetinsky

Crop diversification by incorporating pulse crops in the rotation is greatly benefiting producers with greater stability of income and new marketing strategies. Further value-added processing will enhance these benefits. Present concerns of high nitrogen fertilizer costs will further increase pulse acres and the use of pulse products.

The present pulse research program at Barrhead is a growing partnership of AAFRD Specialists (including CDCN), private industry (Alberta, Canada, and International), the Gateway Research Organization, as well as key participation from the Alberta Pulse Growers (Zones 3, 4 and 5). The projects are primarily on field pea agronomic parameters with some work being conducted on fababean cultivars and agronomy.

Funding for all projects is being obtained either from the pulse industry sponsors or through AARI On Farm Demonstration program.

Additions in year 2000 included securing funding and construction of a drying oven (200 sample size) at Barrhead and the construction of a 50 foot, 3 point hitch, plot sprayer for the research program.

Research Projects

The AAFRD team in conjunction with APG-Zone 3 has developed pulse research and demonstration programs dating back to 1984. In 2000, the priorities and projects were developed by industry needs with assistance from various AAFRD staff and coordinated and conducted by Ken J. Lopetinsky with assistance from APG-Zone 3 staff; Glen Pullishy and Sheryl Strydhorst.

Western Canada field pea co-operative trial

One of the 12 sites across Western Canada is maintained at Westlock, representing a total of 82 cultivars in three blocks. Complete agronomic data, yield and samples for food quality analysis were collected and submitted to Morden, Manitoba. Results are published in the Prairie Registration Recommending Committee for Grain—Special Crops Subcommittee Report (annual). Data is used to support registration of new field pea cultivars.

Alberta region pulse trials

Evaluation of 22 cultivars in the yellow pea regional and 14 cultivars in the green pea regional were conducted at two locations to provide Alberta producers with updated variety data. These two sites are part of Area 3 data for the provincial program and results are published annually in Agdex 140/32-1, *Varieties of Special Crops for Alberta*. In addition, eight fababean cultivars were tested at two locations.

Pre screening and evaluation of new field pea genetics

In partnership with Advanta Seeds (Winnipeg, Manitoba) and Cebeco Zaden (the Netherlands), a total of 26 cultivars were pre screened for adaptability at six locations — two Advanta Seeds locations and four Cebeco locations. Further partnering with Randy Bjorklund, AAFRD and Robyn Russell, Agricore provided two locations outside Area 3 (wet zone) with locations at Andrew and Camrose.

In addition, Plant Breeder Rights (PBR) tests and descriptions were conducted for Advanta and Cebeco on 14 field pea candidate cultivars and one fababean candidate cultivar against recognized reference cultivars. This is a two-year data collection and variety description process funded by private industry.

Fababean trials — new genetics

In partnership with St. Denis Seeds and several producers, two new Fababean types with European genetics were monitored at various locations. Additional cooperation from BASF (formerly Cyanimid) was incorporated to research several herbicides for broadleaf weed control in fababeans at three locations. Some herbicides show great promise and the project will be continued in 2001.

Pea inoculant research program

Biological signal molecule field pea inoculants were evaluated with first year partners AAFC (Lacombe) and Bios Agriculture (Quebec). This study was conducted at three locations and overseen by team leader Dr. George Clayton. Testing new legume inoculants for optimum nitrogen fixation and yield is important and requires further study. In addition, a partnership with MBR (MicroBioRhizogen), Saskatoon, Saskatchewan was established to evaluate new strains of field pea inoculant and compare various formulations. Partnered with LiphaTech, another study was organized to evaluate phosphate effects on granular inoculant viability when mixed. Time intervals included 0, 1, 2, 3 days and yield comparisons were made with and without the added phosphate in the seed row. First year data is promising and the project will be continued in 2001.

New millennium silage trial

In partnership with Pulse and Special Crops Specialists, four locations were seeded (Oliver, Barrhead, Vermilion, Grande Prairie) to compare various seeding rates of Barley and Triticale with Swing and Performance 4010 field pea as well as sole crop to intercrop mixtures. Biomass yield and crude protein were determined for 16 treatments at each location. The program was developed at Barrhead, where all seed ratios for all seed plots were supplied (total of 320 sub plots). Graphs for biomass yield, per cent crude protein, and crude protein yield were developed at Barrhead for each location.

Field pea research partnership with Alberta pulse growers — Zone 3

Based on priorities set by a committee, this is a continuing program that provides new information affecting profitable production of field pea in Alberta. Projects include: Evaluation of Soil and Foliar Micronutrients on Field Pea Yield; Evaluation of Special Purpose Field Pea Cultivars; Field Evaluation of Ascochyta Blight Control on Field Pea; Evaluation of Two Gramminicide Application Dates for Field Pea Yield and Grassy Weed Control; Evaluation of New Field Pea Varieties in Northwest Alberta.

In addition the following two new projects will commence in 2001: Effects of Seeding Date and Chemical Seed Treatments on Rhizoctonia Blight of Field Pea; Lygus Bug Control in Fababean Crops in NW Alberta.

Technology Transfer Services

The further development of a Team Approach to Agronomic Research resulted in more technology transfer activities in new areas of the province. This included presentations at the annual meetings of Zone 2, 3, and 4 of the Alberta Pulse Growers. A total of seven field tours were conducted with industry partners to see first hand differences in various project treatments of many programs in the area. Attendance has kept pace with the number of tours, however future changes are planned to better facilitate train the trainer activities. In 2000, a team approach developed the new pulse and new crops modules at the Ellerslie Diagnostic School, providing a new method of technology transfer for many specialists. Written articles and radio talks highlighted the pulse industry's new results in 2000.

Special Crops Program (Brooks)

M. Bandara, C. Wildschut, E. Russell, L. Ost, T. Simo and J. Webber

The special crops program at the CDCS at Brooks is primarily responsible for the evaluation, introduction, and development of alternative, or new (special) crops for southern Alberta through applied and adaptive research projects. Some study projects are conducted in collaboration with other research programs at CDCS, other divisions of Alberta Agriculture, Food and Rural Development (AAFRD), Agriculture and Agrifood Canada, University of Alberta, the Crop Development Centre at the University of Saskatchewan, Regional Research Associations and industry partners. Different funding sources such as Farming for the Future Matching Grants and Direct Funding Grants, regional and cooperative varietal testing programs and several processing industry partners, provide the financial support for the programs.

Agronomic and physiological studies are conducted on pulses, herbs and spices, medicinal and essential oil crops. Considerable time is invested on new cultivar/line and species evaluation studies. A small component of the program is the testing of new cultivars and breeding lines of cereals and oilseeds under irrigation.

Detailed project results are presented in CDCS pamphlet 2000-20, *Special Crops Cultivar Trials*.

Research Projects

Regional/cooperative trials

Newly developed breeding lines and promising cultivars of lentils, chickpeas, drybeans, fieldpeas, fenugreek, and mustard received from various crop breeding programs are evaluated under dry land and irrigated conditions in southern Alberta, to select suitable cultivars/lines for the region.

Drybean cultivar evaluation and cultural practices

Ten yield tests, with various drybean lines and varieties, were conducted at Brooks and Bow Island under irrigated conditions to gather data for screening, registration and recommendation purposes.

Breeding programs at the Lethbridge Research Center, Agriculture and Agrifood Canada and the Saskatoon Crop Development Centre at the University of Saskatchewan, are developing promising lines of this type of drybean. Four lines B one great northern, one black and two navy B were recommended for varietal registration by the Prairie Registration Recommending Committee for Grains (PRRCG).

Three irrigated locations in southern Alberta were established to test these newly registered cultivars in wide and narrow row configurations, under auspices of the Special Crops Regional Varietal Testing Program.

Other pulse crops cultivar evaluation and cultural practices

Twelve fieldpeas cultivar trials were conducted at Brooks, Bow Island, Standard, Douglas Farm (a dry land test site north of Brooks), Barons and Milk River to evaluate lines and varieties for screening and regional adaptation purposes. Brooks was the only irrigated site. Four yellow and six green type fieldpea lines were recommended for varietal registration by the PRRCG in 2000. Most lines were higher yielding than Carneval, generally earlier maturing and showed acceptable disease resistance and quality characteristics. In 2000, 26 sites in different geographic regions and soil zones of Alberta and the Peace region of British Columbia were established to test these newly registered fieldpea varieties.

Different lines and registered varieties of other pulse crops, such as lentils, chickpeas and soybeans were again evaluated for registration and regional adaptation. Five kabuli and five desi type chickpea regional tests were established under dry land conditions at Bow Island, Brooks, Standard, Barons and Carmangay. All sites were harvested, but due to severe drought only the kabuli type test at Bow Island and the desi type tests at Standard, Douglas Farm and Bow Island produced marginally reasonable yields.

Other special crop cultivar evaluations and cultural practices

Several cultivars and lines of canary seed, mustard, natto soybeans, fenugreek and hybrids of sunflowers, silage and grain corn were evaluated for potential registration and regional adaptation.

Cereal Yield and Varietal Trials

Three barley and four wheat trials were conducted under irrigation at Brooks in conjunction with the Field Crop Development Center in Lacombe. The barley tests included 2 row (15 lines), 6 row (14 lines) and hulless (12 lines); the wheat tests included soft white spring (6 lines), hard red spring (19 lines), durum (11 lines), and a utility test (15 lines) combined with triticale (6 lines). Data was collected throughout the season for growth habits, disease, pests, maturity and yield. The tests suffered from poor and uneven germination, but recovered sufficiently during the growing season. Maturity data were very variable and were not used. Samples of the hard red spring wheat were forwarded to Agricore for protein analysis.

Oilseed Yield and Varietal Testing

One flax trial (12 lines) and three canola trials (one rapa with 4 lines and two napus with 28 lines in each trial) were established at CDCS. Again, there was low and uneven germination, resulting in uneven maturity. Data collected was similar to cereal trials.

Fall Seeding Studies

Fall seeding or dormant seeding refers to the planting of a crop species in the fall before freeze-up. The seed remains dormant in the soil during fall and winter months, and germinates in spring when conditions are favorable.

Using the canola crop model, fall seeding studies were established at Beaverlodge, Edmonton and Brooks, using four spice crop species (coriander, dill, anise and mustard) and two pulse crop species (lentils and chickpeas). Different seeding rates (1 x, 2 x and 4 x) and seed-coated with plastic polymers were the treatments. Crop performance will be compared with spring seeded crops.

Fifteen lentil cultivars from the Crop Development Centre of the University of Saskatchewan were seeded at CDCS in the fall of 2000. One half of the seed of each cultivar was coated with plastic polymer and the other half was uncoated (untreated control). Cultivar and coat treatment effects on winter survival, crop growth and seed yield will be assessed in the 2001 cropping season. Crop phenology and seed quality will be compared with the spring-seeded crop.

Seed Priming Studies

Coriander, a member of the *Apiaceae* (*Umbellifecae*) family is characterized by slow and erratic germination and poor seedling emergence. Previous studies have shown that seed priming can enhance and synchronize seed germination in several slow germination species. A study was conducted using two cultivars of coriander (small-fruited cultivar PGR 5741 and larger-fruited cultivar ND-1) to evaluate effect of different priming treatments (water for 24 or 36 h, 0.5 or 0.75 per cent ethyl alcohol for 12 h) on seedling establishment, plant growth, crop maturity and fruit yield. Results indicated that priming treatments improved the stand establishment, but had no effect on final plant height or fruit yield. All priming treatments produced an evenly matured crop compared to the untreated control. The treatments, however, had no impact on the time of maturity. Uniform crop maturity would be the main beneficial effect of the priming treatment for coriander.

Evaluation of Calendula as an Industrial Crop for the Prairies

Calendula is a flowering annual grown as an ornamental and medicinal plant throughout the Prairies. Calendula flowers have been used as a source of medicinal ingredients for over 100 years. The medicinal compounds include triterpenes, flavonoids, carotenoids, polysaccharides and sterols that contribute to the anti-inflammatory and immuno-stimulatory properties of the plant. Calendula also accumulates a fatty acid in its

seed oil, which is known as calendic acid. This is the most rapidly oxidized fatty acid known in nature and as such has an extensive number of applications in the plastics, paints and coating industries. Two separate studies were established to evaluate the effect of genotype, location, seeding rate, seeding date, late flower bud removal, on crop growth, seed yield, seed oil content and oil composition under field conditions in southern Alberta.

Study 1—Calendula cultivar x seeding date study: This study included two cultivars, Resina (yellow flowered, early maturing and large seeded) and Erfurter Orangefarbigen (orange flowered, late maturing and small seeded) and three spring seeding dates (May 3, 18 and 31). The crop was grown with supplementary irrigation. Both cultivars seeded on May 3, 18 and 31 were harvested on August 25, September 7 and October 12 respectively, indicating that crop maturity of the two cultivars was comparable under the growing conditions in the 2000 cropping season. In both cultivars, the early seeded crop produced higher quality seed compared to that of the late seeded, even though seeding date had no significant impact on total seed yield.

Study 2—Seeding rate x date for flower bud harvest: This study was established on May 18, 2000 using calendula cultivar Erfurter Orangefarbigen at two seeding rates, 6 and 12 kg/ha in a randomized complete block design. Late flower bud harvest treatments were imposed at 3 growth stages, early stage of seed formation (Aug 13), green seed stage (Aug. 23) and seed turned brown (Sept. 3) stages. The crop was grown with supplementary irrigation. All treatments were harvested on September 30, 2000. Excessive moisture conditions caused crop lodging and delayed maturity and harvest, resulting in an approximate 30 per cent seed loss. In general late flower bud removal had no impact on seed yield. A higher seeding rate resulted in a significant increase in seed yield. Both cultivars suffered from aster yellows disease, but the percentage of the incidence was relatively low compared to the 1999 cropping season. Essential oil content extraction and quality analysis are in progress at the Crop Development Centre, University of Saskatchewan.

Intercropping studies

A preliminary study was established to evaluate the interaction effects of several field crops (field peas, barley, silage corn) and spice crops (coriander, fenugreek and mustard) on their growth traits when grown as intercrops under field conditions. The main goal is to select crop combinations that have synergistic effect on plant growth so that those comparable crops can be used to develop efficient crop production systems in southern Alberta. Observations indicated the fenugreek and field peas grown as intercrops with silage corn at 50 per cent plant population appears to be compatible and highly productive than other crop combinations. Barley and mustard were highly competitive crops and suppressed the growth of less competitive intercrops such as fenugreek, fieldpeas and coriander.

Effect of physical property of the fruit on yield and composition of essential oil of coriander (*Coriandrum sativum* L.)

Coriander is one of the most extensively grown spice/essential oil crops in the Canadian Prairies. The essential oil content of dried fruit varies between 0.03 to 2.5 per cent and the fixed oil content varies between 9.9 to 27.7 per cent. The main component, linalool, is used as the quality parameter for coriander essential oil. One of the main factors influencing the essential oil yield and quality of coriander is physical property (mean fruit weight, split or crushed fruit per cent) of the fruit lot. This study examined the effect of physical property of coriander fruit on the recovery rate, composition and total yield of essential oil using unnamed coriander fruits obtained from the crops grown at six locations in southern Alberta. Treatments were whole, split and ground fruits. Approximately 150 g of cleaned fruit samples were used for each treatment and replicated twice. The essential oil extraction was performed using hydro-distillation method.

Results indicated that mean fruit weight, degree of fruit crushing and extraction time had a significant impact on total yield and quality of essential oil. On average, small fruit (9 to 11 g/1000 fruits) produced over a 1.6 fold increase in essential oil yield compared to that of larger fruited treatments (15 to 17 g/1000 fruits). The essential oil extracted from whole fruit was superior in quality since the oil had significantly higher linalool content compared to other treatments. However, the ground fruit treatment consistently produced significantly higher oil yield than whole and split treatments and as a result the ground treatment produced the highest linalool yield among the treatment. Grinding of fruit prior to hydro-distillation enhanced the oil recovery rate and as a result reduced the oil extraction period by at least 1.5 hours. In summary, results of the present study indicate that grinding of fruit prior to hydro-distillation improves essential oil recovery rate, total essential oil yield and total linalool yields of both small-and large-fruited coriander, while splitting of fruit improves total oil yield, particularly in small-fruited coriander.

Crop selection and improvement

Seed of *Echinacea angustifolia*, *E. pallida, E. purpurea,* borage and stolons of peppermint, spearmint and Alaskan mint were treated with ester of Methyl Sulphonate (EMS; mutegenic compound). Treated seeds and stolons were planted in plugs or pots and placed in a greenhouse. In early spring, both *Echinacea* and mint species were transplanted in the field. *Echinacea* species will be evaluated for aster yellows disease resistance and medicinal quality. The mint species for over wintering ability and essential oil contents. Foliage of individual mint plants grown from the treated stolons was harvested and stored at -20°C prior to oil extraction. Oil extraction and composition analysis are in progress. Plants of both species were mulched with barley straw in mid October prior to freeze-up. Plant growth performance, essential oil yield and quality for mint, and medicinal qualities and aster yellows resistance for *Echinacea* will be determined in early spring. Seed harvested from the plants grown from EMS-treated seed will be field planted in the spring of 2001 for crop selection purpose. Crop selections of borage will be carried out based on seed shattering, crop maturity, and seed oil content and quality.

Evaluation and selection of different lines/selections of essential oil, spice and health promoting crops are conducted for adaptability under the growing conditions in southern Alberta and to develop management practices for improved and sustainable production. Plant species included in this evaluation are coriander, dill, rosemary, lavender and mint.

Technology Transfer Services

Program staff continued to answer numerous inquiries on the production of special crops, particularly on herb, spice and essential oil crops. Information on special crops was made available to producer newsletters and news media and the special crop variety performance fact sheet was updated. Program staff participated in courses, seminars and field tours. Demonstration plots of various special crops, including herbs, spices, essential oil, medicinal plants and other new crops at Brooks and Bow Island were visited by a large number of interested individuals and groups. Extension staff and other interested parties were provided with planting materials for demonstration and field testing to assist herb, essential oil and spice producers evaluate new crops and to develop agronomic practices.

The Special Crops Regional Variety Testing Program was coordinated, prepared and distributed. Performance data of registered varieties of fieldpeas, dry beans, lentils, fababeans and mustard was summarized and made available to cooperators, specialists, growers and agribusinesses.

The program staff cooperated with AVEC and supplied Echinacea for dehydration trials.

Special Crops Program (Beaverlodge)

R. El Hafid

Recognizing the lack of a special crops research initiative serving the Peace region, AAFRD proceeded with the recruitment of a research scientist in July 2000. The entire initiative is identified as the Crop Diversification Centre Peace (CDC Peace, located at the AAFC Beaverlodge Research Farm) to complement and collaborate with the special crops research programs at CDCN and CDCS. It is administered through the CDCN. This new initiative is indicative of the collaboration and partnership between Agriculture and Agri-Food Canada and Alberta Agriculture to ensure that the Peace region has a strong research framework to develop new technologies for the entire zone.

The mandate of this program is to promote crop diversification and new crop development, mainly in northern Alberta, with the ultimate objective of fostering economic viability and sustainability of the special crops industry in the Peace River Region.

El Hafid joined his position in July. It was, therefore, too late to conduct field experiments in spring. Since July, he participated in many conferences and meetings with researchers, producers, and other industry partners in and out of the province in order to get a better understanding of the challenges and opportunities facing agriculture in general and crop diversification in particular in the province. Based on the information gathered from these meetings, El Hafid elaborated a research program addressing some of those agricultural challenges.

Research Projects

Fall seeding studies

Field experiments were established in October 2000 at three different locations in the province (CDCN, CDCS and CDC Peace). The proposed project will examine the practicality and feasibility of fall seeding practice of several special crops (four spice crops and two pulse crops) and its impact on seed yield and quality under contrast production environments in Alberta.

Technology Transfer Services

The following activities summarize the technology transfer services provided by the program leader: received and answered numerous inquires regarding a wide range of new crops production; provided some producers with copies of written materials on many aspects related to the agronomics of special crops.

Interviewed by the CKUA radio on crop diversification opportunities in the Peace region, and potential agronomic research in this area; published an article on crop diversification in the "Peace Views" newsletter; joined the team working on developing a hemp CD; and wrote three sections on hemp botany and biology, hemp history, and hemp global status.

Attended many producers and scientific meetings in Alberta and also in other prairie provinces.

Weed Science Program

C. Neeser and B. Kruger

The objective of the weed science research program at CDCS is to develop optimal weed management strategies for vegetable, potato, pulse, fruit, nursery, and other specialty crops. Research includes projects on chemical as well as non-chemical weed management methods.

Research Projects

Weed control in vegetable crops

Onion — This crop is slow growing and produces a very open canopy. Onions are therefore poor competitors with weeds. Preemergent or early postemergent herbicides with good residual activity are commonly used for weed control. Due to the limited choice of herbicides available for this crop, there is a need to increase the number of registered herbicides and herbicide tank mixes. In previous trials Pardner® (bromoxynil) has shown potential for use in onion. To further assess this use another trial was conducted involving tank mixtures of Pardner®, Prowl® (pendimethalin) and Goal® (oxyfluorfen), which were applied to Norstar onions at the 1-2 leaf stage. Additional tank mixtures including Pardner®, Attain® A (fluroxypyr) and Afolan® (linuron) were applied at the 2-3 or 3-4 leaf stages.

These applications resulted in minimal crop injury with average ratings no higher than 4.5 per cent . Injury symptoms were most apparent with the Pardner®-Prowl®-Attain® A mixture. At the second observation date (three weeks later) injury symptoms had mostly disappeared and there were no significant differences between treatments. This was also reflected in the yield measurements where there were no significant differences between treatments.

Carrots — Carrots are slow to produce a competitive crop canopy. Effective weed management tools are required to lower weed management costs and to minimize potential negative impacts resulting from repetitive equipment traffic. To this effect it is advantageous to apply herbicides in the form of a mixture.

Lorox® (linuron) is commonly used in carrots as pre or postemergence herbicide to control a wide range of broadleaf weeds as well as some grasses. Grassy weeds not controlled by Lorox® can be killed with Poast® (sethoxydim). At this time Poast® is not a registered tank-mix with Lorox®. Therefore, we conducted a trial to test the performance of Lorox® /Poast® tank-mixes at various rates.

Noticeable injury was only observed at high rates of Lorox® (1.1 kg a.i./ha). The tank mixtures resulted in lower weed control than separate applications of the two herbicides. Best overall control was obtained with Lorox® applied at 0.55 kg a.i./ha at the 1-2 leaf-stage followed by Poast® at the 2-leaf stage. Broadleaf weed control was best with an application of Lorox® at 0.35 kg a.i./ha at the 1-leaf stage, followed by the same rate at the 2-leaf stage.

Weed control in potato

Weed control is a significant cost in potato production. The average cost of herbicides is estimated at $69 per acre, which represents 30 per cent of the total pesticide cost. The cost of herbicides can vary considerably depending on the particular choice of products. In order to assist producers in making optimal choices a research trial was conducted where the performance of different herbicide programs was compared on two potato varieties (Shepody and Russet Burbank). Herbicides tested included Sencor® (metribuzin), Prism® (rimsulfuron), Lorox® (linuron), Prowl® (pendimethalin), Roundup® (glyphosate) and Poast® (sethoxydim).

Generally there was no yield difference between the various treatments. However, at lower rates (< 0.28 Kg a.i./ha) Sencor did not effectively control wild tomato. At the lowest rate (0.21 kg a.i./ ha) poor control of wild tomato resulted in yield loss in Shepody potatoes, but not in Russet Burbank potatoes. Prowl® in combination with Lorox® produced excellent results, which suggested that Prowl® may be a good candidate for minor use registration to broaden the spectrum of available preemergence grass herbicides.

Weed control in pulse crops

Beans — A research trial was conducted to determine whether the use of ammonium sulfate as a spray additive would influence weed control and bean tolerance to Basagran®. Visual crop injury ratings were performed on two occasions, but no significant differences could be detected at either of the observation dates. Higher averages for the July 18th injury ratings were due to crop damage caused by high salt content in some of the replications. Weed control obtained with ammonium sulfate as the spray additive was not significantly different from weed control obtained with Assist® or Merge® as the spray additive. None of the treatments resulted in yield differences.

Weed control in special crops

Caraway — Caraway is usually a biennial crop, and therefore postemergence weed control is often a necessity. In 1999 a caraway trial was initiated with the objective to compare the performance of Sencor® (metribuzin) and Lorox® (linuron). In the second year (May 2000) caraway was treated with Lorox® at 0.6 kg a.i./ha and 1.2 kg a.i./ha, with a tankmix of Lorox® (0.6 kg a.i./ha) and Poast® (0.21 kg a.i./ha), with Sencor® at 0.21 kg a.i./ha and 0.28 kg a.i./ha, and with 2,4-D amine at 0.45 kg a.i./ha.

Sencor® caused moderate visible injury, and at the high rate (0.28 kg a.i./ha), resulted in significantly lower yield. Severe visible injury occurred with 2,4-D, and yield loss was close to 90 per cent. However, the seed oil content was significantly higher with 2,4-D treatment, although oil yield per hectare was much lower. Sencor® and Lorox® had no significant effect on oil content, but total oil yield was lower when Sencor® was applied at 1.2 kg a.i./ha.

Cut Flowers — Field grown cut flowers can fill a relatively lucrative niche market for small producers. Chemical weed control options in field grown cut flowers are nearly non-existent. A preliminary field screening trial was done to select potential pre and postemergence herbicides. Basagran®, Devrinol®, Edge™, Eptam®, Lontrel™, Lorox®, Pursuit®, and Treflan™ were tested on Aster, Larkspur, Statice, and Zinnia.

Asters and Zinnia were substantially damaged by all products except Pursuit®. The most tolerant species was Larkspur, which was only damaged by Lorox®. Statice showed good tolerance to Edge™, Eptam®, Pursuit®, and Treflan™.

Weed control in berry crops

Black Currant — Black currant is a promising new berry crop in Alberta. Weed control can be a problem during the establishment phase. Given that there are no herbicides as yet registered for this crop, a tolerance trial involving Treflan™ (trifluralin) and Lorox® (linuron) was conducted. Treflan™ was applied pre-plant incorporated at 0. 8 and 1.6 kg a.i./ha, and Lorox® was applied preemergence at 2.0 and 3.0 kg a.i /ha. Tolerance was assessed visually and on proportional increase in plant height over the course of the season. Lorox® at either rate caused slight visible injury (5 to 6 per cent) and resulted in somewhat shorter plants at the end of the season. No injury was observed with Treflan™.

Integrated weed management

Weed seeds — In the absence of new seed input the number of weed seeds in the soil declines over time as a result of various mortality factors. Knowledge of the rate of decline of weed seeds present in the soil has direct implications in designing crop rotations optimized for weed management. A study was initiated in which the rate of seed mortality for a variety of weed species will be determined as a function of different irrigation and tillage regimes. The duration of this study is expected to be five years.

Technology Transfer Services

Weed control recommendations were provided to growers by telephone, letter or office/farm visits, and presentations were made at producer and professional meetings. The weed science program continued to receive a significant number of enquiries concerning safe recropping intervals following the use of persistent herbicides for potato and vegetable crops.

Pest Prevention and Management Unit

Dutch Elm Disease Prevention and Arbor Day Program

J. Feddes-Calpas

Dutch elm disease prevention program

This past year, Alberta Agriculture, Food and Rural Development (AAFRD) Dutch Elm Disease Prevention Program with cooperation of the Society to Prevent Dutch Elm Disease (STOPDED) has again focused on the prevention of Dutch elm disease (DED) in Alberta. Monitoring for the vectors, surveillance of the disease, education and public awareness was completed throughout the entire province. Firewood was also confiscation at the AB-Montana ports of entry. The threat of DED presses Alberta's borders from two sides, Saskatchewan and Montana.

In 2000, monitoring for the two vectors of DED, the smaller European elm bark beetle (SEEBB) and the native elm bark beetle (NEBB), was accomplished by using sticky panel traps and a two component lure (combination of pheromones with host attract ants). The DED Prevention Program was responsible for 195 of a total of 471 traps placed in municipalities, provincial and municipality parks, nurseries and at all the AB-Montana ports of entry. The remainder of the sites were coordinated by city staff in the five major cities. SEEBBs were again captured in Edmonton, Calgary, and Medicine Hat, but in much lower numbers than in previous years. New municipalities to capture beetles were Killam and Lloydminster. No NEBBs were found.

The SEEBBs have been found on a recurring basis since 1994 in Calgary, 1995 in Edmonton and 1998 in Medicine Hat. In the past, other locations to find SEEBBs were Strathcona County, Red Deer, Vauxhall, High River, St. Albert, Balzac, and Coutts.

A total of 74 suspect samples were cultured for the presence of DED, 56 of these samples were submitted by the City of Edmonton. All tested negative for DED, 41 of the City of Edmonton samples have been identified as *Dothiorella ulmi.* As a result of severe dieback associated with *D. ulmi* infection, an overwhelming amount of elm trees in Edmonton have been removed. Due to the increased concern in Alberta, STOPDED has directed funds towards *D. ulmi* research to be done by Dr. Tewari at the U of A. To date, only one case of DED has been reported in AB. In 1998, a single elm tree in Wainwright was tested positive for DED, removed and burned.

Since DED and the vectors can be carried and spread by elm firewood, firewood is confiscated from travelers entering into AB at the AB-Montana ports of entry. During this last summer months, a large amount of firewood was confiscated at Coutts, Carway and Chief Mountain, Del Bonita and Wild Horse ports of entry. Some elm firewood confiscated at Carway was found to have EEBB galleries.

Workshops on DED Prevention and Elm Inventory Computer Program were held in various municipalities. DED Public Awareness Week was recognized throughout the province during the week of May 29-June 2 through the media.

After another season of hard work, Alberta is fortunate to still be DED free. For further information on the Alberta DED Prevention Program, http://www.agric.gov.ab.ca/ded

Arbor day program

Arbor Day was celebrated on May 4. A total of 100,000 trees seedlings (spruce, and lodgepole pine) were distributed to grade one or grade three children across the province. Cooperators for tree distribution were AAFRD, Trans Alta, and the Parks Departments in Edmonton, Calgary, Lethbridge, Red Deer, Medicine Hat, St. Albert, and Strathcona County. The tree seedlings were purchased by AAFRD from Marketland Corp., Bowden.

Meteorological Report

N.G. Seymour and T.T. Pheh

The Alberta Agriculture, Food and Rural Development's CDCS operates two automated weather stations; one at the Centre southeast of Brooks and another at the sub-station southwest of Bow Island.

Brooks (CDCS) — Precipitation is measured with two instruments at the Brooks station. The Tipping Bucket Rain Gauge (TBRG) very accurate in reading rainfall to 0.2 mm is not reliable for recording snowfall. The Fischer-Porter Weighing Gauge (F&P) provides an accurate reading for snowfall equivalent. During the growing season of 2000, Brooks received very little average rainfall while temperatures were near or above the thirty year averages. Total precipitation for the year was only 42 per cent of the 30-year average for Brooks.

The final spring frost of 2000 occurred on May 24 (-0.4°C). The first autumn frost was -0.2°C on September 20, giving a total of 120 frost-free days in 2000. This is higher than the 30-year average (1951-80) of 116 frost-free days (May 21 to September 15).

Table 1. 2000 Brooks (CDCS) Weather Data

	Temperatures (°C)							
	Extremes		Average				Means	
	Max	Min	Max	30 yr av	Min	30 yr av	2000	30 yr av
January	5.7	-29.9	-4.9	-6.9	-17.9	-23.6	-11.4	-12.5
February	9.6	-27.1	-1.2	-2.4	-15.0	-13.9	-8.1	-8.2
March	18.8	-21.5	6.6	3.1	-4.8	-10.6	0.9	-2.7
April	23.0	-11.2	13.2	12.2	-2.1	0.7	5.6	5.1
May	26.2	-3.4	18.9	18.7	3.7	3.5	11.3	11.4
June	30.5	0.5	22.4	23.0	7.7	9.8	15.0	15.9
July	36.1	5.5	28 7	25.9	11.6	11.8	20.2	18.3
August	35.5	3.7	26.3	25.2	10.3	10.9	18.3	17.5
September	30.3	-5.0	19.7	18.9	3.8	5.8	11.8	11.6
October	26.6	-10.5	14.3	13.6	-1.6	-1.4	6.3	6.3
November	15.7	-21.9	1.7	2.1	-11.7	-13.3	-5.0	-3.7
December	9.8	-30.7	-6.7	-4.6	-17.7	-21.3	-12.2	-10.3
Average	22.3	-12.6	11.6	10.7	-2.8	-2.6	4.4	4.1

	Precipitation (mm)			
	2000			1961-90
	TBRG		F&P	30 yr av
January		n/a	3.6	18.4
February		n/a	12.2	11.9
March		n/a	7.4	17.0
April		11.0	11.6	26.9
May		12.8	11.6	39.1
June		28.6	27.5	65.4
July		3.4	2.2	38.0
August		31.4	32.4	36.3
September		24.4	25.2	38.8
October		4.8	4.1	15.8
November		n/a	4.3	14.9
December		n/a	4.1	18.4
Average	Tot.	n/a	146.2	341

Bow Island (Sub-station) — The last recorded frost was 0.2°C on May 24 and the first autumn frost (-0.6°C) occurred on September 21, for a total of 121 frost-free days in 2000, less than the 30-year average (1951-80) growing season at Bow Island of 125 days (May 17 to September 20).

The precipitation recorded during the summer months indicates a very dry growing season in Bow Island. It is important to note that precipitation is only measured with a tipping Bucket Rain Gage which is unreliable during the winter months.

Table 2. 2000 Bow Island Weather Data

	Temperatures (°C)							
	Extremes		Average				Means	
	Max	Min	Max	30 yr av	Min	30 yr av	2000	30 yr av
January	5.8	-29.7	-3.8	-5.2	-15.9	-15.9	-9.8	-10.6
February	11.7	-26.4	0.1	-0.9	-12.4	-11.7	-6.1	-6.3
March*	12.6	-20.7	4.5	4.7	-5.2	-6.6	-0.3	-0.9
April	24.5	-12.0	13.4	12.5	-1.1	0.2	6.2	6.6
May	27.8	-3.4	19.2	19.2	4.5	5.5	11.8	12.4
June	28.2	1.4	21.5	24.4	8.1	10.7	14.8	17.6
July	34.8	6.1	27.6	27.6	10.8	12.1	19.2	19.7
August	34.9	5.3	26.5	27.1	10.1	11.9	18.3	19.6
September	31.0	-4.3	19.4	20.2	4.8	5.6	12.1	12.9
October	26.2	-10.0	14.0	15.0	-0.5	0.5	6.8	7.6
November	17.2	-19.0	3.4	4.7	-10.0	-6.6	-3.3	-1.0
December	13.1	-33.2	-5.7	-2.8	-16.7	-13.0	-11.2	-7.9
Average	22.3	-12.2	11.7	12.2	-2.0	-0.6	4.9	5.8

* Data for March may be inaccurate because the station was not functioning from March 16-29.

	Precipitation (mm)		
	2000		1961-90
		TBRG	30 yr av
January		3.5	18.6
February		5.6	11.3
March*		1.0	13.1
April		11.7	34.2
May		6.1	44.9
June		47.0	69.8
July		3.8	30.9
August		16.8	32.4
September		27.2	30.4
October		8.6	12.3
November		2.8	12.8
December		2.5	19.0
Average	Tot.	137	330

* Data for March may be inaccurate because the station was not functioning from March 16-29.

Edmonton (CDCN)

Table 3. 2000 Edmonton (CDCN) Weather Data

	Temperatures °C					
	Extremes		Average		Means	
	Max	Min	Max	Min	2000	30 yrs
January	5.43	-30.99	-7.99	-19.72	-13.86	-10.1
February	7.18	-31.7	-1.18	-17.33	-9.26	-9.8
March	14.82	-30.96	2.11	-8.59	-3.24	-3.3
April	23.89	-14.59	10.39	-2.68	3.86	5
May	21.76	-2.5	15.27	2.7	8.99	11.05
June	27.43	0.02	19.72	7.84	13.78	14.75
July	29.42	6.19	23.24	11.24	17.24	16
August	29.03	5.15	21.24	9.34	15.29	15.4
September	25.8	-1.9	16.9	4.2	10.55	11
October	23.12	-11.91	11.01	-2.2	4.41	4.5
November	9.69	-22.15	1.77	-10.4	-4.32	-5.3
December	7.12	-32.41	-8.53	-19.5	-14.02	-10.1
Averages	18.72	-13.98	8.66	-3.76	2.45	3.26

	Precipitation			
	Snow (cm)		Rain (mm)	
	2000	Average	2000	Average
January	27.0	20.3	4.9	2.6
February	6.9	16.5	**	3.5
March	20.6	12.9	6.7	2.2
April	12.8	11.7	18.5	12.4
May	0	10.9	33.5	46.8
June	0	0	69.7	91.4
July	0	0	93.7	91.6
August	0	4	31.2	73.3
September	0	2.5	38.1	42.6
October	0	6.5	3.9	11.5
November	**	13.5	2.2	3.7
December	**	21.4	4.3	2.7
Total	67.3	120.2	306.7	384.3

** no record taken

Heat Units* at CDCN calculated from last to first killing frost.**

May	101
June	245
July	379
August	319
September	175
Total	1219

Last killing frost — May 9, 2000

First killing frost — September 23, 2000

* Calculation based on 5°C base temperature.
** Killing frost is taken as minus 2°C.

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G. Hooke, Journeyman Landscape Gardener ..... Chemical Applicator and Gardener, CDCN
A. Kosinki ..... Mechanic, CDCN
B. Merkl ..... Mechanic, CDCS
S. Milne ..... Irrigation Technician, CDCN
R. Williams ..... Senior Mechanic, CDCS
W. Wise ..... Farm Manager, CDCS

Arrivals

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Administrative Support Staff

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P. Fulton ..... Administrative Support, CDCN
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B.A. Humphreys ..... Receptionist/Timekeeper, CDCS
A. Moeller ..... Accountant, CDCS
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